THURSDAY, SEPTEMBER 22, 1881

EGYPTIAN EXCAVATIONS AND MUMMIES

THE recent excavations in Egypt have been productive of great results to archæology and the history of Egypt. One site, which has yielded unexpected additions to the early period of the country, has been excavated on scientific principles under the direction of M. Maspero, the present superintendent or director of the Archæological Department. It is his intention to open the whole group of unexplored pyramids, in order to find the sequence of monarchs of whom they were the sepulchres, and to discover any inscriptions with which they may have been decorated. An examination of the whole group of pyramids indeed was formerly made by J. Shay Perring, C.E., at the expense of Col. Howard Vyse, who spent a fortune in pyramidal researches; but the excavations of Perring were chiefly devoted to the examination of three great pyramids of Gizeh, those of Cheops, Chephren, and Mycerinus, and although he examined the whole group in the scientific manner of an engineer, by some fatality he appears not to have penetrated into the interior of the smaller ones, which are now in process of examination by M. Maspero. The conviction which that *savant* has arrived at is that these pyramids are arranged in symmetrical groups, each group holding the remains of the monarchs who followed each other in chronological succession. The group just discovered consists of three pyramids at Sakkara, of small dimensions, lying to the N. and E. of the step-shaped pyramid, and on the road to the Serapeum, the sepulchres of three monarchs of the sixth dynasty, Ra-meri or Mira, whose name was Pepi or Phiops, a king who is said to have reigned 100 years all but an hour; his successor, Merienra, named Har-em-saf, or Ta-em-saf, and a king called Una. They seem all to have been constructed on the same principle, having inclined entrances leading to sepulchral chambers with pointed roofs, the walls of the passages and chambers covered with hieroglyphs coloured green, the ceilings of the sepulchral chambers with pointed roofs on which were stars in white upon a black ground, indicative of the hours of the night. The inscriptions of these chambers are of interest purely mythological, no historical fact or allusion being mentioned in them, but their contents consisting of prayers similar to those in the Book of the Dead, or Ritual, and chiefly referring to the myth of Osiris and Hades, especially the identification of the kings with Osiris as the son of Nut and Seb, and his following the course of the constellation Orion, rising and setting with that constellation, allied with the star *Sebt*, or Sothis, and the progress of the king to the *Aahlu* or Egyptian Elysium, and in the account of the Island of the Fields of Ho-tep, or Peace, recalling to mind Eden, mention is made of a tree of life. In the Pyramid of Pepi, the Phiops of the sixth dynasty, who is said by the history of Manetho to have reigned 100 years all but an hour, and who must consequently have ascended the throne quite a boy, was found the remains of a sarcophagus of black and white granite of unfinished work, which had been broken, and another in the south-east corner of the chamber of the same material, which had been let into the masonry. In the vicinity of this sarcophagus on the west side between this and the wall was found amidst a heap of rubbish remains of dresses and mummy bandages varying from yellow to dark brown of extreme fineness; of the mummy itself an embalmed hand in good condition was only found, and even this may be considered remarkable, as the bodies of the earlier period were only dried, and not embalmed, and generally fall to pieces when exposed to air. The pyramid was indeed small, considering the long reign of Pepi. The Pyramid of Merienra, or Har-em-saf, which resembled in general character that of Pepi or Phiops, had two sarcophagi of red granite close to one another, the cover of one removed and hidden under blocks of stone. The other held a body mummied, which was that of the king; it had been anciently plundered of its ornaments, but embalmed with the greatest care, the skin well preserved, the traits of the countenance distinct, the eyes closed, the end of the nose fallen in, the stature of medium height, and the limbs youthful. This king was the successor of Phiops. The third pyramid of the group was of Noferkara or Nephercheres, but no details of the inscriptions have as yet been published, although they probably refer to the Osiris myth, like the others. The details of the size of coffins and mummies of this pyramid are still wanting. Each pyramid had a special name: that of Pepi was called Mennefer, that of Ha-rem-saf was Shanefer, that of Noferkara also Mennefer. Compared with the great Pyramids of Gizeh, they are far inferior, but the inscriptions in them offer an interest greater than that of the plain Gizeh Pyramids. The only question is whether the mummies found in them are contemporaneous with the sixth dynasty, which appears most probable, or subsequent usurpations, of which there is no monumental or inscribed evidence.

The next remarkable discovery is that of the thirty-nine mummies, several of kings, in a subterraneous well or pit not very far from the edifice of the Deir-el-Bahari. This remarkable structure, consisting of a temple on a platform with chambers let into the solid rock, had been published by Marriette Pasha, and had been suspected by Brugsch Bey to be the site of the sepulchres of the early monarchs of the eighteenth dynasty. The temple itself had been commenced by the queen Hatasu or Hasheps, daughter of Thothmes I. and wife of Thothmes II., and its sculptures commemorated the expedition made by that queen to Punt or Somali, the treasures brought from thence in gold, silver, frankincense, besides trees of that material, besides giraffes, cynocephali, large dogs. Besides which they give representations of the inhabitants and of the Egyptian fleet which descended the Red Sea on the voyage of amity or discovery promoted by the Egyptian queen.

In the well or pit of the Deir-el-Bahari, which was formed of bricks of conical shape stamped with inscriptions, on which could be traced the titles of the high priest of Amen-ra thus used by the monarchs of the twenty-first dynasty, were found the coffins, mummies, and other objects which appear to have been there deposited in the reign of Herhor, first monarch of the twenty-first dynasty, and of another king, Panetem or Pinotem, of the same dynasty. The cause of the removal of the mummies deposited in the Theban sepulchres, such as the El Assasif and the Biban-el-Molook, is stated on some of the wraps of the mummies to have been the apprehension

of a foreign invasion, and that possibly of the Assyrians, whose arms had made great progress in Central Asia. According to Brugsch Bey the twenty-second dynasty was Assyrian, and he identifies the name of the monarch with that race; but at all events they were never Assyrian monarchs, such names as Shashanq or Shishak, Namrutha or Nimrod, not having been found in the Assyrian annals, although Uasarkan or Sargon, and Takelloth or Diglath may correspond with Assyrian kings.

From the El Assasif had been removed the mummy of Taakan, also known as Skanenra, which was formerly deposited at the Drah Abu-el-Neggah with its three inscribed coffins, and which was intact at the time of Rameses IX. about B.C. 1150. It was in his reign that the quarrel of the Egyptian kings with the Shepherd Kings commenced, and he is mentioned in the celebrated Sallier Papyrus. The mummy of Aahmes or Amosis I. in three plain cases was also found amongst the coffins, but it is not known where this king was buried; as he succeeded Skanenra, his tomb was probably somewhere in the vicinity. The mummy of Aahmes Nefertari was also found, it is said, in three cartonages with paintings on a white ground. Another queen, Aahhotep, daughter of the King Aahmes, was also found, and it will be recollected that this was the name of the queen whose mummy and coffins, and gold and silver jewellery, and arms were discovered by fellaheen at the Biban-el-Molook, a few feet below the surface. She was wife of Kames and mother of Aahmes, while the queen of the Deir-el-Bahari was the wife of Amenophis I. The mummy of Amenhotep I. or Amenophis was found in a wonderful state of preservation, painted and varnished, and with wreaths of flowers so exquisitely preserved that they retain all their colour like recent flowers kept and pressed between the leaves of books. These flowers, it will be remembered, are above 3000 years old, and their preservation is probably due to their having been buried in hot sand, a mode still in use in Palestine, by which means botanical specimens retain their colour for a long time unchanged, a process perhaps known to the ancient Egyptians, although wreaths and flowers, even of the Roman times, from Egypt are brown and semicarbonised. The tomb of Amenophis I. is mentioned as at the Drah Abu-el-Neggah in the Abbot Papyrus, and the body transported thence of Thothmes I., his son; the mummy case, considerably mutilated, was only found, and this had been appropriated by Pinotem. The mummy of Thothmes II., in three mummy cases, was likewise discovered. That of Thothmes III., the great and warlike monarch of the eighteenth dynasty, was found in a single coffin much mutilated, his body broken into three pieces and rifled in ancient times, but with an inscribed ritualistic linen roll said to prove the identity of the mummy. Of the other personages of the eighteenth dynasty were the mummies and coffins of the Prince Saamen, the Princess Satamen, a princess and king's sister, but unmarried, named Hanta-em-hu; and a similar royal sister and queen named Me-han-ta-emhu, child of Hanta-ena-hu, had been removed at the time of the twenty-first dynasty; another unmarried queen-sister named Miramen, and Nebseni, a priest or flamen of a Pharaoh. All these coffins of the eighteenth dynasty have a certain similarity with each other. Those of the nineteenth are Rameses I., whose tomb and sarcophagus are at the Biban-el-Molook. There is some uncertainty in the different accounts which have come to hand whether there are three coffins or one, and if the mummy was deposited at the Deir-el-Bahari. The mummy of Seti I., whose tomb is in the Biban-el-Molook and alabaster sarcophagus in the Soane Museum of London, is well preserved in one wooden coffin; the mummy of one of the Ramessids, apparently the twelfth, not the second, as reported, in a plain coffin, the features not aquiline, but the shroud, covered with lotus flowers, looking remarkably fresh; this also came from the Biban-el-Molook. These mummies, it is stated, were removed under apprehension of a foreign invasion. Then follow the cases and mummies of the twenty-first dynasty. The queen, Notem, mother or wife of Herhor, of whom there is a papyrus in the British Museum, exhibited by H.R.H. the Prince of Wales, in a badly-preserved but inlaid coffin; Panotem or Pinotem, high-priest of Amen, in three coffins of the style called *richi* by Marriette, and gilded faces; he was, besides high-priest, a *saten sa Kush*, Prince of Cush or Æthiopia, according to the inscription in Lepsius' *Königsbuch;* the queen, Ramaka or Makarra, who assumed the same prenominal title as Hatasu of the eighteenth dynasty, who is in three coffins with the youthful queen, called the "lady of the two countries," or absolute queen-heiress, embalmed in a sitting posture, either having died in a fit or at her birth, and named Mutemhat; the king, Pinotem II., hastily deposited in the coffins of Thothnes I., the mummy has been partially unwrapped and the features exposed, which have a singular resemblance to those of Voltaire, with a sarcastic or satiric smile or grin, a peculiarity also found on a hieratic papyrus ritual in the British Museum, probably of the same period; the queen-mother, Hantau, whose ritual had found its way to the Boolak Museum prior to the discovery; in three cases, the prince Masaharuta, son of Pinotem II. in the same; the queen Asemkheb or Hesemkheb, in as many cases, who appears to have been the wife of Menkheperra; another princess called Nasikhonsu; Tet-ptahaufankha in an appropriate coffin, and four other priests and functionaries. Several other objects were found in the pit: a leather tent embroidered with names, boxes with royal names, boards with inscriptions, and five rituals of the monarchs of the later dynasty; but the whole of the details—amulets, inscriptions, and style of art—cannot be known until the mummies are unrolled and all peculiarities carefully examined, for this remarkable find will afford invaluable data for Egyptian archæology, especially the sepulchral division.

TWO SPIDER BOOKS

The Spiders of Dorset, with an Appendix containing Descriptions of those British Species not yet found in Dorsetshire. By the Rev. Octavius Pickard-Cambridge, M.A., C.M.Z.S., &c. From the *Proceedings* of the Dorset Natural History and Antiquarian Field Club, edited by Prof. James Buckman. (Sherborne: L. H. Ruegg, pp. 1-625, with 6 plates, 1879-1881, 8vo.)

Studi sui Ragni malesi e papuani. Per T. Thorell. III. Ragni dell' Austro-Malesia e del Capo York, conservati nel Museo Civico di Storia Naturali di Genoa. Pp. 1-720. 8vo. (Genoa, 1881.)

IF we take down part 2 of vol. i. of the twelfth edition of Linné's "Systema Naturæ" (1767) and refer to that marvellously incongruous order *Aptera*, in which the

old naturalist contrived to group together nearly all the Arthropods known to him and which agreed almost solely in the one point of the non-possession of wings, we find under the genus "*Aranea*" only 47 species indicated, and of these only 9 are from outside Europe. In the second edition of the "Fauna Suecica" (1761) we find 33 species indicated for Scandinavia. Thus six years later all the spiders known to Linné from outside his native country amounted to 14 species! At the present time 518 species are recorded as British, and a still almost unexplored region of the Eastern Archipelago has contributed nearly as many from the researches of one or two naturalist-travellers, with whom spider-collecting was certainly not considered of first importance. And yet, notwithstanding the vast and rapid strides that arachnology has made within the twenty years past, the number of workers is still small. The subject is not always an attractive one to naturalists, and is often repugnant to non-naturalists, with whom a passion for collecting or studying spiders is seldom associated with respect for the naturalist thus smitten. But all this is rapidly changing, and no two men have done more to bring this about than the authors of the books noticed below.

In vol. xxi. p. 273, we noticed vol. i. of Mr. Pickard-Cambridge's work; vol. ii., completing it, is now before us. The whole is dedicated to John Blackwall, and the second volume must have appeared about the time of the decease of that venerable naturalist. A postscript notices some species new for the county or for Britain, and there are additional remarks on senses and economy, in which "sight," "touch and hearing," "power to utter sounds," "venom," "modes of forming snares," &c., are severally alluded to. With regard to "venom," the author expresses his firm belief that the bite of the common garden geometric spider (*Epeira diademata*) is attended by the emission of a poisonous fluid, sufficiently strong to cause visible effects on the skin of his young son, but without effect upon his own. He now agrees with the conclusion that currents of air play a great part in enabling spiders to carry their lines across from one object to another, although previously he was of opinion that the lines were carried across by the spiders themselves. As we remarked when noticing vol. i., it is a pity the author did not intercalate the descriptions of those British species not yet found in Dorsetshire amongst the others, instead of placing them in appendices at the end. This would have vastly increased the usefulness of what is still a most useful work, and while not destroying its local intentions (as indicated by the title) would have rendered it more distinctly a *Manual of British Spiders*, for such it really is. With it and Blackwall's magnificently illustrated Ray Society monograph before him, no student of our spider-fauna should be at a loss to determine, with approximate certainty, any species he may come across. The six plain plates are excellent, engraved from the author's own drawings, and representing many of the principal genera, with copious details. The index is full. The author recognises 518 species of spiders as inhabiting the British Isles, of which 373 have been found in Dorsetshire. The distribution of these amongst the several families is strikingly unequal. Thus we find three families represented by only one species each; another by only three species. On the other hand the *Theridieides* claim 267 species, the *Drassides* 56, the *Epeirides* 32, and so on. Possibly this is the first time that any thoroughly local society has undertaken to bring out a manual of a large group of British animals; so much the more to the credit of the Dorset Society for initiating so laudable a scheme. Their undertaking, so well concluded, is not of local (or even British) interest only, but will have to be considered by every European student of *Arachnida*.

In Dr. Thorell's bulky memoir (which forms vol. xxii. of the *Annali del Museo Civico di Genoa*) the author continues his studies on the Spiders of the Eastern Archipelago. The descriptions are worked out with his well-known detail and accuracy. Most of the materials result from the exploring voyages of D'Albertis and Beccari, and the flourishing society under whose auspices the volume is published deserves the highest credit for the promptness with which it is making known to the scientific world the riches acquired during the voyages of these renowned travellers. The descriptive portion is preceded by a bibliographical sketch of what was previously known from the regions, with an analytical and comparative examination of the arachnid fauna generally, still further subdivided in a series of tables at the end; 317 species are noticed as in the collection (of which 173 appeared to be new to science), viz. 252 from Austro-Malesia and 82 from Cape York, but 505 are recorded for the whole of that part of the globe, divided as follows:—*Orbitelariæ*, 162 species; *Retitelariæ*, 38; *Tubitelariæ*, 31; *Territelariæ*, 10; *Laterigradæ*, 84; *Citigradæ*, 29; and *Saltigradæ*, 151. Some idea of the riches of the fauna in this particular respect may be gathered from the fact that no less than eighteen species of the extraordinary genus *Gasteracantha* are described. We cannot resist a few words of admiration at the manner in which the publications of this Italian society are got up, the more so as the printing is done at the Deaf and Dumb Institute of Genoa (Istituto Sordo-Muti). Paper, typography, and editing alike leave nothing to be desired.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

The Oldest-known Insects

I MUST ask your permission to correct the errors into which your correspondent, Dr. Hagen, has fallen respecting the Erian (Devonian) beds near St. John, New Brunswick, holding certain fossil insects described by Dr. Scudder.

The Dadoxylon sandstone and Cordaite shale of the vicinity of St. John have been studied not only by myself, but by so good geologists as Prof. Hartt, Prof. Bailey, and Mr. Matthew, and by the officers of the Geological Survey of Canada; and their stratigraphical relations have been illustrated by maps and sections, not only in my "Acadian Geology," but in the *Reports* of the Geological Survey, more especially those for 1871 and 1875. They have, besides, been thoroughly exposed and ransacked for fossils by expensive quarrying operations undertaken by the Natural History Society of St. John, and their plants have been described and compared in detail with those of the neighbouring Carboniferous formations in my Report "On the Devo-

nian Plants of Canada," and subsequent Reports on the plants of the Lower Carboniferous and Millstone Grit formations (Geol. Survey of Canada, 1871 and 1873). In these circumstances it seems strange that the received conclusions as to their age should be termed "simple negation not supported by facts," and regarded as of no scientific value in comparison with the mere assertion of a gentleman who has no knowledge whatever of the stratigraphy of the region, and with the "authority" of Dr. Heer, who is no doubt an excellent authority on certain departments of European palæobotany, but who has not seen the beds in question, nor, so far as I am aware, studied their fossils.

The beds referred to, like the Devonian generally in Eastern Canada, underlie unconformably the lowest Carboniferous beds, a circumstance due apparently to the extensive igneous action which closed the Devonian period in this region, giving origin to masses and dykes of intrusive granite, and disturbing and partially altering the strata of Devonian and greater age, the materials of which have contributed to the Lower Carboniferous conglomerates. There is thus no question here as to any transition between Devonian and Carboniferous, and the beds holding the plants and insects are stratigraphically pre-Carboniferous.

The Lower Carboniferous beds, succeeding to the Devonian formation, and developed to the eastward of St. John, hold the characteristic flora of the Horton series, or Lowest Carboniferous, equivalent to the Calciferous or Tweedian formation of Scotland. In succession to this we have the flora of the Millstone grit, of the true Coal-Measures, and of the Permo-Carboniferous or Lower Permian. All of these have been explored and their plants catalogued and described in my own memoirs or in the reports of the Geological Survey, and it has been fully established that the flora of the Devonian beds is characteristic and distinct from any of these sub-floras of the Carboniferous.

The plants of the Cordaite shales are not only distinguishable from those of the Carboniferous found in their vicinity, but the assemblage includes forms like *Psilophyton* and *Archæopteris*, which are characteristic of the Devonian, and are not found in the Carboniferous elsewhere in America. In the Devonian of Northern New Brunswick some of these plants are associated with fishes of the genera *Cephalaspis*, *Pterichthys*, &c., well-known Devonian types.

For additional information as to the geological relations of the St. John plant beds and notices of new species, I may refer to my paper on "New Erian Plants," in the *Journal* of the Geological Society of London, vol. xxxvii., May, 1881. This paper Dr. Hagen had probably not seen at the time when his letter was written.

The particular fern in question, *Pecopteris serrulata* of Hartt, has been fully described, first by Prof. Hartt, and subsequently by myself, and its distinctness from *P. plumosa* pointed out.[1] The criticism of Dr. Hagen, as to its not appearing in the sectional lists, and still being called by me a common fern, is based on a mere accident, which I could easily have explained to him. The plants referred to as found in each layer in the detailed section are those originally described by me from these beds. Some species, subsequently recognised and described by Hartt, were not included in the sectional lists, and were referred to only in a note, because I had received no information from Prof. Hartt as to the particular layers in which they were found, though I knew that some of them were by no means uncommon, from the number of specimen obtained. Dr. Hagen criticises my figure of the species, but that does not affect the question, as I have compared the specimen on the slab with *Platephemera* with the original specimens in my collection. My figures, however, show fairly the general form of the frond; and there is also a magnified figure of a pinnule, showing the venation, which should enable any one to recognise the species, and with the aid of the description to distinguish it from *P. plumosa*.

With regard to the "Ursa stage" of my respected friend Dr. Heer, founded on a little known and apparently exceptional locality, I have always objected to its being made a standard of comparison for the thoroughly worked and widely distributed Devonian or Erian rocks of North America. I gave some reasons for this in a paper sent to the Geological Society of London shortly after the appearance of Dr. Heer's memoir, an abstract of which appears in the *Proceedings* of the Society. It will be sufficient to say here that the grounds on which Dr. Heer refers the Devonian of New Brunswick to the Ursa stage would apply to the Chenning, and even to the Hamilton formations of the New York series.

[1] "Acadian Geology: Report on Devonian Plants." *Canadian Naturalist*, 1881.

The great richness of the Devonian of North America in fossil plants is a very remarkable geological fact, which I regret to say has hitherto far exceeded the means available for its adequate illustration. I hope, however, to remedy this to some extent on the occasion of the meeting of the American Association in Montreal in 1882, when my whole collection of Erian plants, together with those illustrating the several stages of the Carboniferous, will be exhibited in the new Peter Redpath Museum, and will show more fully than has been hitherto possible the progress of the American flora from the Silurian to the Permian. It will be a great pleasure to me if any palæobotanists who are sceptical as to the magnitude of the Devonian flora will avail themselves of this opportunity to judge for themselves and to form their own opinions as to the affinities and relations of the species.

McGill College, Montreal, September 2 J. W. DAWSON

Sound-producing Ants

I AM glad to see my statement in NATURE, vol. xxii. p. 583, verified by Mr. H. O. Forbes, from Sumatra, and now inclose a few ants of another kind that make this peculiar tapping or scratching sound, though not in the same system of taps as those before noted, and that was thus—

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i.e. three taps in unison and a pause of about a second, the taps of equal duration. The ants inclosed make a series — — — — — — — that dies off and does not seem repeated unless the exciting cause again acts, when they again start in beautiful unison. How they so correctly start together in all cases of - - - — or the — — — — — - - - and keep each tap in time, is really wonderful. White ants make similar tappings, but not in rhythm as far as I know, and they use it to call or warn. These little black ants cannot be heard by us unless the material they are on is sensitively sonorous. Happening to place a tumbler on a sideboard lately in the dark, I was startled to hear this — — — — — — - arise from a sugar-bowl. I repeated it, and the noise at once convinced me that it was ants. On getting a light I found a sheet of writing paper had been laid on the bowl, and was covered by them; the glass alone was useless, I found. S. E. PEAL

Asam, July 6

[The ants sent are apparently "workers" of a species not larger than a small British *Myrmica*.—ED.]

Wasps

A COUPLE of weeks ago I found on my window-pane a large black wasp holding in its mandibles a plump spider of about an eighth of an inch in diameter. I placed the wasp under a bell-glass and set it on my desk, where I could readily watch for further developments. Finding itself in captivity, the wasp dropped its booty and spent some time in trying to find a way of escape. Coming at length to a state of rest, it espied the spider and sprang upon it with tiger-like fierceness. Seizing it and raising itself up to its full height, the wasp brought its posterior under and forward with a quick motion, and gave the spider, two or three thrusts with its sting. Assured that the spider was dead, the wasp proceeded to roll it over and over, rapidly working it up into a globular mass. This done it started to fly away; but, foiled in the attempt, it dropped the spider, which was for some time apparently forgotten. This whole operation I saw several times repeated during the two days of my observations. Being called away from home for a few days, I was curious on my return to ascertain the results of my experiment. I had taken the precaution at the first to place under the bell-glass a small dish of clean water, to which the wasp had helped itself freely. I found the wasp dead; but not the least morsel of the spider had it eaten. My conclusions are: (1) that the wasp died of starvation; (2) that the spider was intended, not for its own food, but for that of its young in their larval state. In confirmation of this I have broken open several of the finished cells of these wasps, and found them filled with pellets made of portions of spiders, flies, and worms. Only yesterday a fine opportunity was afforded me for further observations in this direction. One of my flowering vines is infested with a green worm—the larva of the yellow butterfly. I discovered a bronze-and-yellow wasp standing on the edge of a leaf of this vine, holding fast to one of these worms of twice its own size. The worm was dangling in mid-air, and the wasp endeavoured laboriously for a long time to pull it up on the surface of the leaf.

Failing in this, with a dexterity worthy of the Knight of the Shears it cut the worm in two, letting about three-fourths of it fall to the ground. The remainder was then easily dragged to the surface of the leaf, where the wasp spent some fifteen minutes in cutting down, trimming, and reducing it to a globular mass of about an eighth of an inch in diameter. Then resting for a few minutes, and taking a fresh hold of its booty, it flew briskly away. J. T. BROWNELL

Lyons, N.Y., August 13

Treatment of Hay Fever

SOME years ago Prof. Helmholtz, in a letter to you, gave an account of a remedy he had found for "hay fever." This was simply to treat the part of the nose, which seems to be the seat of the trouble, with sulphate of quinine solution by pouring it into the nose with a pipette, while lying on a sofa with the head turned upside down. Having had the most enjoyable part of summer destroyed by hay fever ever since I can remember, I have tried every remedy I have heard of, including internal doses of arsenic, and I have found them all to fail. Prof. Helmholtz's method only gives me relief for ten minutes or so, and cold water does the same. I have tried solutions of sulphate of zinc and tannin, and many other astringents, but all to no purpose. As many others knew that I was experimenting upon myself in this matter, I have had several patients trying all the remedies that I have tried, and I can therefore say with certainty that no remedy yet published will cure hay fever. I have however succeeded in finding a method which is a really effectual cure, and as I know that many are rendered miserable during the most enjoyable part of the year, I hasten to give them the benefit of the result of my inquiries. One thing which misled me was that my eyes were often very much inflamed and pained during an attack, and I often tried remedies for my eyes (which have sometimes gone wrong when I had no hay fever) when they were only affected in sympathy with my nose. I found that the only thing required was to prevent the entrance of the pollen grains into the nose. When there are not many in the air, as during or after rain, it is simply necessary to stop the nose with a spring clip. I have used a piece of brass or steel ribbon bent double, and having only sufficient spring to close the nostrils without undue pressure. This causes the patient to breathe by the mouth, but one soon gets accustomed to the inconvenience. I found that to stop the nostrils with cotton wool was far too irritating, especially as those afflicted with hay fever are so owing to the tenderness of the internal coating of the nose. When going amongst hay a further precaution must be taken, viz., plugging the ducts from the eyes. I used for this purpose dumb-bell shaped pieces of glass, which are easily slipped into the ducts, and can be removed when wanted. Thus protected, any one who is troubled by hay fever can go into the camp of the enemy and stir up hay in a field with as much impunity as one not troubled with this "sixth sense." The season for hay fever is nearly passed now, but I hope that the publication of this note will be the cause of relief to many during next summer, and on that plea I ask its publication in your valuable journal, and I hope that medical men in the South of England, where hay fever is common, will give it a trial and report upon it next summer. In Scotland hay fever is practically unknown. J. B. HANNAY

Cove Castle, Loch Long, N.B.

Red Rainbows

PROF. S. P. THOMPSON'S letter (p. 459) makes me recall that when on September 2 last year I crossed Wales westwardly from Hereford, on a fine sunny day, the train ran into a misty shower after 6 p.m. at Machynlleth, and out of it as we neared the viaduct at Barmouth. The sun had been obscured for some time, when it suddenly shone out through a chink between sea and cloud, causing in the east a very beautiful red rainbow. Like Prof. Thompson, I was under the impression that the phenomenon was of no uncommon occurrence, so did nothing more than note it in my diary. HENRY MUIRHEAD

Cambuslang, September 16

Infusorial Parasites on Stickleback

ONE day in June, when examining a very small stickleback under the microscope, I was surprised to find it infested by numbers of infusoria, evidently parasitic upon it. This led me to examine others from the same water, viz., a pond very rich in infusorial life generally, as also specimens from the river close at hand. Every specimen from the pond was similarly attacked, while none of those from the river were so. The parasite is apparently *Trichodina pediculus*, which is stated to be parasitic upon *Hydra vulgaris*. Want of literature on the subject has prevented me from following the matter up, but it seems that I have found, if not a new species, at least a new host for a known species. I shall be glad if any of the readers of NATURE can give me any information on the subject. N. H. POOLE

Charterhouse, Godalming

Photographing Diffraction Rings—Optical Phenomenon

THE peculiar character of the photographs of an opening to the sky in the dark Cyclopean gallery at Tiryns, to which Mr. W. J. Stillman calls attention (NATURE, vol. xxiv. p. 260), finds an obvious explanation in the well-known optical phenomenon of diffraction rings, produced when a beam of light is transmitted through a small circular aperture, and viewed by means of a lens. Had your "Cecropian" correspondent examined the image of the illuminated opening by the assistance of a lens, the phenomenon of concentric coloured rings would, doubtless, have been recognisable to the eye. Hence the only point of interest in the phenomenon observed by Mr. Stillman is the significant fact that in securing the fleeting images of the rings on the gelatine plate—the actinic rays being alone effective—alternate dark and bright concentric rings are produced, as in the case of homogeneous or monochromatic light, instead of the coloured rings seen by interposing a lens between the aperture and the eye. In other terms, the impressions on the gelatine plate being due to the action of the monochromatic actinic rays, the theory of diffraction shows that the concentric rings should be alternately dark and bright. This is an important circumstance in the applications of photography to such investigations.

Berkeley, California, August 16 JOHN LE CONTE

A Primitive Diving-Bell

IN NATURE, vol. xxiv. p. 201, it is stated that Herr Bulde has found a description of a primitive diving-bell in a work of Bartolini, 1674. The inventor appears to have been Franciscus Kesler, 1616. This description of Kesler's diving machine will also be found, together with representations of the same, in Schwenter's "Deliciæ Physico-Mathematicæ," 1636, a very rare and curious volume; so rare indeed that it is stated in *Cosmos*, January 27, 1860, "it is not to be found in the Imperial Library, nor in any of the public libraries of Paris." J. van Lennep, in *Notes and Queries*, December 15, 1859, p. 503, says "there is a Dutch translation of Schwenter, 1672; of this rare volume I fortunately possess a copy." N. S. HEINEKEN

Sidmouth, September 11

ITTAVIO LAUDI.—Messrs. Trübner, publishers, London, might be able to help you to get copies of the Chinese translations mentioned in Mr. Fryer's articles on "Science in China."

FREDERICK CURREY, M.A., F.R.S.

THE late Frederick Currey, whose death was announced in last week's NATURE, p. 475, was born at Eltham on August 4, 1819, educated at Eton and Trinity College, Cambridge, there obtaining a scholarship, and attaining his B.A. in 1841; three years later he proceeded to M.A., and was called to the Bar, afterwards practising as conveyancer and equity draughtsman.

His first public performance as a scientific writer was a translation of Schach's "Das Mikroskop" in 1853, a second edition of which was called for within two years. In the *Microscopical Journal* for 1854 he published some observations on two new fungi, and by the same channel he afterwards communicated several papers, chiefly on the obscure points in the reproduction of the lower cryptogams. The Greenwich Natural History Club was established in 1852, Mr. Currey being one of the earliest members, and the next year he read a paper on the

"Fungi of the Neighbourhood of Greenwich," which was printed in the fifth volume of the *Phytologist*. In 1857 a committee of that Club was appointed to draw up a report on the flora of the district; Mr. Currey was chosen its chairman, and drafted the report, which enumerated 395 fungi. In that year he contributed a paper to the Royal Society, which was printed in the *Proceedings*, On the Occurrence of Amorphous Starch in a Tuberaceous Fungus, a point of much interest, as starch is rarely found in fungi. He was elected Fellow of the Linnean Society in 1856, and in 1858 Fellow of the Royal Society also; in 1860 he was appointed secretary of the former society in succession to Mr. J. J. Bennett, a post which he held until 1880, when he relinquished that office and acceded to the less arduous duties of treasurer, retaining that appointment until his death. In 1862 the Ray Society issued a translation, with considerable additions, from Hofmeister, entitled "On the Germination, Development, and Fructification of the Higher Cryptogamia," a task which Mr. Currey undertook in 1859; the following year he edited a second edition of Dr. Badham's "Esculent Funguses of England," in which he made as few alterations as possible. Several papers on mycological subjects appear in the *Transactions* of the Linnean Society, which will be found in the "Catalogue of Scientific Papers," under his name, his last contribution being, "On a Collection of Fungi made by Mr. Sulpiz Kurz," in 1876.

By his death the Linnean Society has lost an experienced officer, and its members a valued friend whose place it will be hard to fill.

THE AMERICAN ASSOCIATION

THE thirtieth meeting of the American Association for the Advancement of Science commenced at Cincinnati on August 16. Always a hot place in summer, the temperature at Cincinnati during the past two months has been at intervals unusually high, running above 100° for several days together. This and the fear of its recurrence no doubt induced many to stay away who would otherwise have been present. However, a goodly number —over 400—of new members were enrolled, and many papers of interest were read. Some of the visitors from the Eastern States were amazed to find that Cincinnati was not a little backwoods town, but a city deserving in many ways the title she claims, "The Queen City of the West." The ignorance of many of the inhabitants of the Eastern States in regard to the West is only equalled by the ignorance of Europeans in regard to America generally.

The citizens of Cincinnati exerted themselves to welcome their guests, and did it well. Their bodily wants were amply supplied, and this, to those coming from a distance and being strangers, was a matter of no small moment. Visitors known or bearing introductions were in very many cases entertained privately, and a free lunch was provided by subscription for all members daily from 1 to 2.30 p.m. The Western Union Telegraph Company, whose wires extend over almost the whole Union, gave the members the use of their lines for communication with their families, free of charge, at whatever distance they might be situated. Connection was made by telephone between the hall of meeting and the Central Telegraph Office, and between the various rooms in the building, so that it was possible to send a message without leaving the building—to ask, for example, what paper was being read in any other section. The City and Suburban Telegraph and Telephone Companies also extended the same privileges to members of the Association. The various Express Companies offered to convey light parcels containing specimens for them, free of charge, between their homes and the place of meeting, and heavy ones at low rates. Of course there was a post-office and a parcels office in the hall, with convenience and materials for writing. There was however a little deficiency in finger placards to direct strangers over the great building in which the meetings were held—the new music hall.

Besides the above, an excursion was arranged for Saturday afternoon to the Zoological Garden, one of the best in the country, and capable, if well supported, of becoming *the* best. Free transportation through the streets by the horse cars was provided, and a sumptuous repast prepared for the visitors before leaving. In the same way the Anthropological Section and others were taken out to Madisonville, about ten miles from the city, on Monday to see a prehistoric cemetery recently discovered, from which several hundred skeletons, uncounted arrow-points, animal bones, horns, and teeth, and pieces of pottery have been exhumed during the past two years. The train stopped at the place to set them down, and again on its return to take them up. After the adjournment of the meeting an excursion was arranged to the Mammoth Cave, about 150 miles distant, and another to Chattanooga, about 300 miles over the new Southern Railway, both free so far as the travelling was concerned.

It will be evident that Cincinnati did her best to entertain her scientific visitors, and the latter carried away pleasant and lasting impressions of the city where the fifth and the thirtieth meetings of the Association were held, the latter having been one of the most successful in its history. E. W. CLAYPOLE

Another correspondent writes :—

The Cincinnati meeting proved to be one of the best ever held by the Association. In attendance of members it was much surpassed by the Boston meeting last year, which reached the phenomenal number of 997; the number at Cincinnati was about 550, being more than double that at any previous meeting in the West. Over 400 persons joined the Association. Nearly 200 papers were presented; it is not derogatory to any author to say that these papers were of average interest only, and comprised no startling announcements. The general management was very successful. The chief feature of the meeting was the adoption of the important changes in the constitution which are expected to simplify business in the future. If any complaint can be made, it is of the rather generous disposition on the part of the Sectional Committees towards authors whose productions are of doubtful novelty and uncertain value. There is a tendency also to overrun the allotted time; papers for which twenty-five minutes are asked consume seventy minutes, and those of ten minutes extend to thirty minutes. The remedy of this evil lies with the chairmen of the sections, and it is hoped that they will hereafter exert their powers more frequently. The social features of the meeting were very enjoyable; the reception at Highland House, and the daily lunches served in the Exhibition building brought together citizens and members in pleasant intercourse.

Prof. Wm. B. Rogers of Boston, the first presiding officer of the Association, was elected an Honorary Fellow, on the unanimous recommendation of both Sections A and B. Prof. Rogers is the first Honorary Fellow chosen by the Association.

The amendments to the constitution proposed at the Boston meeting were adopted almost unanimously. They provide for the formation of nine sections, as follows:—A, Mathematics and Astronomy; B, Physics; C, Chemistry; D, Mechanical Science; E, Geology and Geography; F, Biology; G, Histology and Microscopy; H, Anthropology; I, Economic Science and Statistics.

Each of the above Sections is to have its own chairman, who is also Vice-President of the Society, and its own Secretary. The amended constitution also creates the office of Assistant-General Secretary, makes certain changes in the composition of the Standing Committee,

and of the nominating committee. These alterations make the organisation more like that of the British Association for the Advancement of Science, and became necessary on account of the recent rapid growth of the Association. The membership has doubled within two years, being now about 1800.

The recommendation of the Standing Committee to meet in 1882 at Montreal was adopted with acclamation. The invitation from Minneapolis for 1883 was referred to the Standing Committee.

The Association elected Dr. J. W. Dawson of Montreal President for the ensuing year. The time of meeting was fixed for the fourth Wednesday in August, 1882. Nearly seventy Fellows were elected by ballot, and the following officers for 1882, in accordance with the recommendation of the Nominating Committee, were unanimously elected :—

Officers for 1882. Vice-presidents : Section A, Mathematics and Astronomy, Prof. William Harkness, U.S.N.; Section B, Physics, Prof. T. C. Mendenhall of Columbus; Section C, Chemistry, Prof. H. Carrington Bolton, Ph.D., of Hartford, Conn.; Section D, Mechanical Science, Prof. W. P. Trowbridge, Ph.D., of Columbia College, New York; Section E, Geology, Prof. E. T. Cox of San Francisco; Section F, Biology, Capt. W. H. Dall of Washington, D.C.; Section G, Histology and Microscopy, Prof. A. H. Tuttle of Columbus, Ohio; Section H, Anthropology, Prof. Daniel Wilson of Toronto; Section I, Economic Science and Statistics, E. B. Elliot of Washington, D.C.

We have already (vol. xxiv. p. 455) referred to the action taken by the Association in reference to science degrees.

The following are some of the principal papers read at the meeting :—

In Section A : Magnetic survey of Missouri, by Prof. F. E. Nipher; on the methods of determining the solar parallax with special reference to the coming transit of Venus, by Prof. William Harkness; on the wave-lengths of the principal lines of the solar spectrum, by Prof. T. C. Mendenhall; experiments to determine the comparative strength of globes and cylinders of the same diameter and thickness of sides, by Samuel Marsden; historic notes on cosmic physiology, by Dr. T. Sterry Hunt; upon the use of the induction balance as a means of determining the location of leaden bullets imbedded in the human body, by Prof. Alex. Graham Bell; upon a new form of electric probe, by the same; on a new method of applying water-power of small head to effect the direct compression of air to any required high pressure, by Prof. H. T. Eddy; the needle telephone, a new instrument by Dr. Goodman of Louisville, Ky., by Dr. J. Lawrence Smith; an improved sonometer, by W. Le Conte Stevens; on the great outburst in comet *b*, 1881, observed at the Cincinnati Observatory, by Prof. Ormond Stone; method of determining the value of the solar parallax from meridian observations of Mars, by Prof. J. R. Eastman; numbers of cometary orbits relative to perihelion distance, by Prof. H. A. Newton; numerical elements of the orbits of the seven electrical vortices to whose motions atmospheric storms are principally due, with the processes by which they have been derived, and examples given of the application of the formula by which their positions on the surface of the earth can be computed for any given time, by Thomas Bassnett; a preliminary investigation of the two causes of lateral deviation of spherical projectiles, based on the kinetic theory of gases, by Prof. H. T. Eddy; note on the theory of the flight of elongated projectiles, by Prof. H. T. Eddy; on the mechanical principles involved in the flight of the boomerang, by Prof. H. T. Eddy; the electrophore and electric lighting, by Mr. E. B. Elliott; nodular concretions in meteoric iron, bearing on the origin of same, by Dr. J. Lawrence Smith; an anomalous magnetic property of a specimen of iron, by Dr. J. Lawrence Smith; on the errors to which self-registering clinical thermometers are liable, by Dr. Leonard Waldo; a new radiometer, by Dr. H. Carmichael; a new differential thermometer, by Dr. H. Carmichael; note on an experimental determination of the value of π, by Prof. T. C. Mendenhall; remarks upon, and an exhibition of, Japanese magic mirrors, by the same; on standard time, by E. B. Elliott; note on a comparison of Newcomb's tables of Uranus and Neptune, with those of the same planets by Leverrier, by D. P. Todd; universal energy of light, by Pliny Earle Chase; electricity, magnetism, gravitation—their phenomena considered as the manifestations of one force, by S. S. Parsons.

In Section B : On the influence of the structure of the nerve-fibres upon the production and conduction of nerve-force, by H. D. Schmidt; on the action of pilocarpin in changing the colour of the human hair, by Dr. D. W. Prentiss; the unification of geological nomenclature, by Dr. R. Owen; the life-unit in plants, by Prof. B. D. Halsted; recent discoveries, measurements, and temperature observations made in Mammoth Cave, Ky., by Rev. H. C. Hovey; influence of forests upon streams, by David D. Thompson; note on the segmentation of the vertebrate body, by Charles Sedgwick Minot; phenomena of growth in plants, by D. P. Penhallow; the recurrence of faunas in the Devonian rocks of New York, by H. S. Williams; a contribution to Croll's theory of secular climatal changes, by W. J. McGee; the evidence from the drift of Ohio in regard to the origin of Lake Erie, by E. W. Claypole; on some relations of birds and insects, by S. A. Forbes; Niagara River, its cañon, depth, and wear, by Wm. Hosea Ballou; evolution and its place in geology, by Edward S. Edmunds.

In Section C : Is the law of repetition the dynamic law underlying the science of chemistry? by Miss V. K. Bowers; evidences of atomic motion within molecules in liquids, as based upon the speed of chemical action, by Prof. R. B. Warder; the constitution of the "atom" of science, by Mrs. A. B. Blackwell; the sources of nitrogen in plants, by Prof. W. O. Atwater; notes in experimental chemistry, by Prof. A. B. Prescott; determination of phosphorus in iron, by Dr. J. Lawrence Smith; the liquefaction of glass in contact with water at 250° C., by Prof. H. Carmichael; the chemistry of fish and invertebrates, by Prof. W. O. Atwater; notes in experimental chemistry, by Prof. Albert B. Prescott; the quantitative estimation of nitrogen, by Prof. W. O. Atwater; the quantitative estimation of chlorine, by Prof. W. O. Atwater; the nitrogenous constituents of grasses, by Clifford Richardson.

In Section D (Anthropology) : Animal myths of the Iroquois, by Mrs. Erminnie A. Smith; antiquity of man in America, by W. de Haas; progress of archæological research, by W. de Haas; the mound builders : an inquiry into their assumed southern origin, by W. de Haas.

In Section E (Microscopy) : On a convenient method of expressing micrometrically the relation between English and metric units of length on the same scale, by William A. Rogers and George F. Ballou.

In Section F (Entomology) ; On the length of life of butterflies, by Prof. W. H. Edwards; on the life duration of the Heterocera (moths), by Prof. J. A. Lintner; how does the bee extend its tongue? by A. J. Cook; the egg-case of *Hydrophilus triangularis*, by Dr. C. V. Riley; on the oviposition of *Frodoxus decipiens*, by the same; the cocoon of Gyrinus, by the same; suggestions of co-operation in furthering the study of entomology, by Prof. B. P. Mann.

THE BRITISH ASSOCIATION

REPORTS

Report of the Committee on Tidal Observations in the English Channel and the North Sea, by J. N. Shoolbred.—In the report it was stated that no official reply had been received by the Committee as to having an international datum for observations, or as to maritime governments giving facilities for detailed observations. The Committee urged the desirability of carrying out a series of observations on the Azores. The Portuguese Government had established a station for registering tides, as had also our own Government at Dover. The Committee hoped before long to have a series of observations giving most important results.

Report of the Committee for Underground Temperature, by Prof. Everett.—In the report it was stated that the temperature varied from one degree for 30 feet to one degree for 100 feet in going down beneath the surface of the earth in different places. During the past year observations have been made in the East Manchester coal field, the Talavgoch lead mine, Flintshire, and at the Radstock collieries, Bath. With regard to the observations in the East Manchester coal-field, these were respectively

taken at Ashton Moss, Bredbury, and Nook Pit: the temperatures were as follows:—

Place.	Depth. Feet.	Temperature.
Ashton Moss	2790	85·3
Bredbury Colliery	1020	62·0
Nook Pit	1050	62·3

The increments of temperature would be as follows:—

Place.	Depth. Feet.	Increase of temperature.
Ashton Moss	2790	36·3
Bredbury Colliery	1020	13
Nook Pit	1050	13·3

This gave for each degree of increase, Ashton Moss 76·9 feet, Bredbury 78·5, and Nook Pit, 79 feet. In Flintshire the observations showed great irregularity last year, and the observations taken this year increased the irregularity. The observations were taken at a place in the lead mine at a depth of 660 feet; at this depth the temperature was 62°, 48° being assumed to be the surface temperature which gave an increase of 14° in 660 feet, or 1° in 47 feet. At the Radstock colliery observations were made at three places. The Wells May Pit, 560 feet deep, the Ludlow Pit, 1000 feet, and a third station in the same pit 810 feet deep, the surface temperature being assumed 50°, the rate of increase was found to be 11°·7 in 560 feet, and 13° for both 810 feet and 1000 feet.

Mr. W. M. Hicks read his report *On Recent Progress in Hydrodynamics*, which he related to the investigations undertaken since 1846, the date of Prof. Stokes's well-known report.

A Report of the Committee on Fundamental Invariants, by Prof. Sylvester, was read.

Report of Committee on Mathematical Tables, by James Glaisher, F.R.S.—The author stated that the factor table for the sixth million was now completed and stereotyped, and he had the pleasure to exhibit to the section proofs of the whole of this million taken from the stereotyped plates. The factor tables for the fourth and fifth millions had been already published, so that now the gap of three millions between the tables of Burckhardt (1817) and those of Dase (1861) was completely filled up. The introduction to the sixth million would shortly be completed, when this volume would appear.

Report on the Tertiary Flora of the Basalt of the North of Ireland, drawn up and illustrated by W. H. Bailey, Geological Survey of Ireland.

Mr. Sclater, in the absence of Mr. Thiselton Dyer, presented the *Report of the Committee appointed for the Purpose of Investigating the Natural History of Timor-laut.*—In a letter addressed to Sir Joseph Hooker, director of the Royal Gardens, Kew, Mr. H. O. Forbes had written from Sumatra, offering, if some assistance could be forwarded to him, to attempt an expedition to Timor-laut, for the purpose of investigating its natural history—"an object," as Mr. Forbes stated, "the accomplishment of which is desired both by botanists and zoologists." An application on Mr. Forbes's behalf was accordingly made to the British Association, and a sum of 50*l.* was voted by the General Committee at the Swansea Meeting to be placed at the disposal of the Committee, to whom the conduct of the matter was intrusted. The action taken by the Association was communicated to Mr. Forbes, and a letter was received in reply. This was the most recent information which the Committee possessed as to his plans. It was somewhat doubtful whether, owing to insufficiency of funds, he was able to start. At any rate, the grant made at Swansea remained in the hands of the Committee. The expedition was obviously attended with some difficulty, if not danger. Its success must be largely dependent on fortunate accident. The Committee, however, thought that there was a reasonable chance of the work being done, and therefore recommended their reappointment, and that a further sum of 100*l.* be placed at their disposal.

The *Report of the Committee on the Natural History of Socotra* gave an account of the progress made in working out Prof. Bayley Balfour's collections, and recommended its reappointment with a somewhat extended sphere, so as to embrace the adjoining highlands of Arabia and Somali Land.

A Report by Mr. R. J. Usher *On Caves and Kitchen-Middens at Cappagh, County Waterford*, described an extensive series of kitchen-middens which had been excavated with the aid of the Association grant. One of these filled a cave of considerable extent, the more ancient parts of which had not been yet explored. The excavated parts yielded large quantities of bones and implements which did not furnish very striking results.

The *Report of the Committee for the Investigation of the Influence of Bodily Exercise on the Elimination of Nitrogen*, presented by Mr. North, detailed the delays in commencing the actual investigation, owing to the necessary devising and construction of instruments. It was hoped however that valuable results might be obtained before the meeting at Southampton.

The *Report of the Committee on the Zoological Station at Naples* was read by Mr. Percy Sladen. He stated that the laboratory had added micro-spectroscopic and polariscopic apparatus, a new Du Bois-Reymond's section apparatus, and a valuable series of chemico-physiological apparatus; and the breeding and aërating apparatus have been successfully worked. Two of the monographs of the Fauna and Flora of the Gulf of Naples have been published in the last year, viz., the Ctenophora by Dr. Carl Chun, and the species of the genus Fierasfer by Dr. Carlo Emery. The monographs on the Pantopoda, by Dr. Dohrn; the Corallines, by Solms-Laubach; and on Balanoglossus, by Dr. J. W. Spengel, are in a forward state. The *Zoologische Jahresberichte* for 1880 is in the press, and will be issued in four parts. The novel method of investigating the sea-bottom by means of diving apparatus has been successfully used in many clear portions of the bed near Naples. Many details of improvement have been made, and many fissures and cavities may be explored which are inaccessible to the trawl or the dredge, and sponges, hydroids, actiniæ, bryozoa and planarians, nudibranchs and algæ may be obtained *in situ*. During the year Mr. Allen Harker has studied at the British Association table, chiefly on the circulation and respiration in the polychætous annelids; also Mr. F. G. Penrose, who investigated the circulation in *Solen legumen*. Mr. P. Geddes desires to prosecute special researches during the coming year, and will be accompanied by an assistant. Thirty-four naturalists have worked at the station during the year, many memoirs have been published, large quantities of specimens have been sent to foreign museums and naturalists, as well as micro copical preparations.

Report of the Committee, consisting of Mr. James Heywood, F.R.S., Mr. William Shaen, Mr. Stephen Bourne, Mr. Robert Wilkinson, the Rev. W. Delany, Mr. N. Story Maskelyne, M.P., F.R.S., Dr. Silvanus P. Thompson, Miss Lydia E. Becker, Sir John Lubbock, Bart., M.P., F.R.S., Prof. A. W. Williamson F.R.S., Mrs. Augusta Webster, and Dr. J. H. Gladstone, F.R.S. (Secretary), on the manner in which Rudimentary Science should be taught, and how Examinations should be held therein, in Elementary Schools.—Rudimentary science is taught in public elementary schools in the form of—I. Object lessons; II. Class subjects under article 19, c. 1, of the New Code; III. Specific subjects under Schedule IV. of the same Code; IV. Science subjects preparatory to entering classes in connection with science schools.

I. Object lessons are attempted in a large number of infant schools, and in some instances are very effective in developing the perceptive powers and intelligence of the children; but in other cases they are too formal, and left too much to the junior teachers. In boys' and girls' schools they frequently appear upon the time table, especially where, as in the schools of the London Board, they are looked upon as a necessary part of the instruction: but they are generally given in an unsystematic, and often in an unsatisfactory manner.

II. The teaching of science as a class subject under the Code only commenced last October, and thus no examinations have yet been held under it. Natural history, physical geography, natural philosophy, &c., are mentioned in article 19, c. 1, and it is stated that the instruction should be given "through reading lessons, illustrated, if necessary, by maps, diagrams, specimens, &c."; but the teachers are limited to two subjects, and the old subjects, grammar, history, geography, and needlework naturally retain their place in the great majority of the schools. Suitable reading-books for these rudimentary science subjects have scarcely yet came into existence.

III. The specific subjects of the fourth schedule include mechanics, animal physiology, physical geography, botany, and domestic economy, but only two subjects may be taken (or three if the child has passed Standard VI.); and the schedule also includes English literature, mathematics, Latin, French, and German. Literature is a general favourite; and domestic

economy is obligatory in girls' schools if any specific subject is taken at all; so that the chance of any of the others being introduced is very much diminished. It must also be remembered that these subjects are only allowed to be taught to children in the Fourth Standard and upwards; while only about one-fifth of the children in the boys' and girls' schools are to be found at present in these standards. According to the Report of the Committee of Council for Education recently issued, there were 476,761 children presented for examination in these standards, of whom the following numbers only were examined in the science subjects:—

Mechanics	2,109
Animal physiology	24,725
Physical geography	34,288
Botany	1,853
Domestic economy	50,797

Out of 489 boys' and girls' departments under the London School Board, the specific science subjects were taken up, as follows, during the year 1880:—

Mechanics in	4 departments
Animal physiology in	123 ,,
Physical geography in	112 ,,
Botany in	9 ,,
Domestic economy	172 ,,

Mr. Hance of the Liverpool School Board has favoured us with an account of the systematic scientific instruction which is given in the Board schools of that town by a special science staff. The subject selected for the boys is mechanics as defined in the New Code, with a considerable development in the direction of elementary physics. It has been in operation since 1877, and the results for the year 1880–81 are given in the following table:—

Year 1880-81.	Number presented.	Number passed.	Percentage of passes.
Stage I.	797 ...	442 ...	55·46
,, II.	398 ...	261 ...	65·59
,, III.... ...	122 ...	82 ...	67·21
Total... ...	1317 ...	785	59·6

Domestic economy is also taught to the girls in a similar manner. In Birmingham 1200 scholars are receiving scientific instruction in the schools of the Board, and it is stated that the teachers uniformly find that "it added interest to the work of the school, that the children were eager to be present, and that the lessons were enjoyed, and were in fact giving new life to the schools." The Board have found the results so satisfactory that they are now furnishing their newest school with a laboratory and lecture room.

IV. As to science-teaching which does not fall under the provisions of the New Code it is not probable that any large amount is attempted. In Manchester, however, the Board gives instruction to 404 children, all of whom have passed Standard VI., the highest ordinary standard, in the following subjects: physiology; acoustics, light, and heat; magnetism and electricity; chemistry; practical chemistry; botany. This teaching is illustrated by means of good apparatus, &c., and has had a very beneficial effect upon the science and art classes of the town. When it is considered that the provisions of the Code naturally form, in almost all cases, the extreme limit of what will be attempted in the schools, it is important that they should be placed as high as possible. This will be a great advantage to the stronger schools, and no disadvantage to the weaker ones, as the higher branches of science-teaching will of course be optional. Your committee have, therefore, arrived at the following conclusions:—

I. *As to object lessons.* That it is very desirable that Her Majesty's Inspectors should take object lessons into account in estimating the teaching given in an infant school; and that they should examine the classes in the graded schools wherever object lessons are given.

II. *As to class subjects.* That the teaching of such subjects as natural history, physical geography, natural philosophy, &c., should not necessarily be "through reading lessons," as oral lessons, "illustrated by maps, diagrams, specimens, &c.," are undoubtedly better when given by a teacher duly qualified to handle these subjects. They are of opinion, also, that it will be desirable to allow a larger number of class subjects to be taken up in any particular school, and to give in such case a proportionately increased grant.

III. *As to specific science subjects.* That a knowledge of the facts of nature is an essential part of the education of every child, and that it should be given continuously during the whole of school life from the baby class to the highest standard. Of course in early years this teaching will be very rudimentary; but by developing the child's powers of perception and comparison it will prepare it for a gradual extension of such knowledge. They consider also that the early teaching must be very general, while the later may be more specific; they think, however, that the science subjects as given in Schedule IV. are fairly open to objection, as being somewhat too ambitious in their nomenclature and in their scope, and that they ought not to be attempted unless the child has had a previous training in natural knowledge before entering the fourth standard. Thus the specific scientific subjects ought not to be distinct, as they practically are at present, from the previous teaching; greater latitude of choice might be allowed in them; and while they should not afford technical instruction they should prepare the way for any technical classes or schools into which the children may subsequently enter. In regard to domestic economy they are of opinion that most of the points embraced in the schedule would be useful to boys as well as to girls.

IV. *As to examinations.* That in the appointment of Her Majesty's Inspectors some knowledge of natural science should be considered as absolutely requisite; that in examining the children they should direct their inquiries so as to elicit not so much their knowledge of special facts as their intelligent acquaintance with the world of nature around them; and that this may be much better done by oral examination than by paper work.

SECTION A—Mathematical and Physical

On the Economy of Metal in Conductors of Electricity, by Sir W. Thomson.—The most economical size of the copper conductor for the electric transmission of energy, whether for the electric light or for the performance of mechanical work, would be found by comparing the annual interest of the money value of the copper with the money value of the energy lost in it annually in the heat generated in it by the electric current. The money value of a stated amount of energy had not yet begun to appear in the City price lists. If 10*l.* were taken as the par value of a horse-power night and day for a year, and allowing for the actual value being greater or less (it might be very much greater or very much less) according to circumstances, it was easy to estimate the right quantity of metal to be put into the conductor to convey a current of any stated strength, such as the ordinary strength of current for the powerful arc light, or the ten-fold strength current (of 240 webers) which he (Sir William Thomson) had referred to in his address as practically suitable for delivering 21,000 horse-power of Niagara at 300 miles from the fall. He remarked that (contrary to a very prevalent impression and belief) the gauge to be chosen for the conductor does not depend on the length of it through which the energy is to be transmitted. It depends solely on the strength of the current to be used, supposing the cost of the metal and of a unit of energy to be determined. Let A be the sectional area of the conductor; s the specific resistance (according to bulk) of the metal; and c the strength of the current to be used. The energy converted into heat and so lost, per second per centimetre, is sc^2/A ergs. Let p be the proportion of the whole time during which, in the course of a year, this current is kept flowing. There being $31\frac{1}{2}$ million seconds in a year, the loss of energy per annum is

$$31{\cdot}5\times10^6 psc^2/A \text{ ergs} \quad . \quad . \quad . \quad (1)$$

The cost of this, if E be the cost of an erg, is

$$31{\cdot}5\times10^6 psc^2\,E/A \quad . \quad . \quad . \quad (2)$$

Let V be the money value of the metal per cubic centimetre. The cost of possessing it, per centimetre of length of the wire, at 5 per cent. per annum, is

$$VA/20 \quad . \quad . \quad . \quad . \quad (3)$$

Hence the whole annual cost, by interest on the value of the metal, and by loss of energy in it, is

$$\frac{1}{20}VA + \frac{31{\cdot}5\times10^6 psc^2E}{A} \quad . \quad . \quad . \quad (4)$$

The amount of A to make this a minimum (which is also that which makes the two constituents of the loss equal) is as follows:—

$$A = \sqrt{\left(31{\cdot}5\,.\,10^6 psc^2E/\frac{V}{20}\right)}$$
$$= c\sqrt{(63\,.\,10^7 psE/V)} \quad . \quad . \quad (5)$$

Taking 70*l.* per ton as the price of copper of high conductivity (known as "conductivity copper" in the metal market), we have ·00007*l.* as the price of a gramme. Multiplying this by 8·9 (the specific gravity of copper), we find, as the price of a cubic centimetre,

$$V = \cdot 00062l. \quad . \quad . \quad . \quad . \quad (6)$$

and the assumption of 10*l.* as the par value of one horse-power day and night for 365 days gives, as the price of an erg,

$$10l./(31\tfrac{1}{2}\times 10^{6}\times 74\times 10^{8}) = \frac{1}{23\times 10^{14}} \text{ of } 1l. \quad (7)$$

Supposing the actual price to be at the rate of $e\times 10l.$ for the horse-power year, we have

$$E = \frac{e}{23\times 10^{14}} \text{ of } 1l. \quad . \quad . \quad . \quad (8)$$

Lastly, for the specific resistance of copper we have

$$s = 1640 \quad . \quad . \quad . \quad . \quad (9)$$

Using (8) and (9) in (5) we find,

$$A = c\sqrt{\frac{63\times 10^{7}\times 1640\times pe}{23\times 10^{18}\times \cdot 00062}} = c\sqrt{\frac{pe}{1\cdot 38}} \quad . \quad (10)$$

Suppose, for example, $p = \cdot 5$ (that is, electric work through the conductor for twelve hours of every day of the year to be provided for), and $e = 1$. These supppositions correspond fairly well to ordinary electric transmission of energy in towns for light, according to present arrangements. We have—

$$A = c\sqrt{\frac{1}{27\cdot 6}} = \frac{c}{5\cdot 25} \doteqdot \cdot 19c.$$

That is to say, the sectional area of the wire in centimetres ought to be about a fiftieth of the strength of the current in webers. Thus, for a powerful arc-light current of 21 webers, the sectional area of the leading wire should be ·4 of a square centimetre, and therefore its diameter (if it is a solid round wire) should be ·71 of a centimetre. If we take $e = \frac{1}{17\cdot 3}$, which corresponds to 1900*l.* a year as the cost of 5250 horse-power (see Presidential Address, Section A), and if we take $p = 1$, that is, reckon for continued night and day electric work through the conductor, we have—

$$A = \frac{c}{\sqrt{381}} \doteqdot \frac{c}{19\cdot 5};$$

and if $c = 24$, $A = 1\cdot 24$, which makes the diameter 1·26 centimetres, or half an inch (as stated in the Presidential Address). But even at Niagara it is not probable that the cost of an erg can be as small as $\frac{1}{1000}$ of what we have taken as the par value for England; and probably therefore a larger diameter for the wire than ½ inch will be better economy if so large a current as 240 webers is to be conducted by it.

Illuminating Powers of Incandescent Vacuum Lamps with Measured Potentials and Measured Currents, by Sir William Thomson and James T. Bottomley.—The electromotive force used in these experiments was derived from Faure secondary batteries, kindly supplied for the purpose by the Société la Force et la Lumière in their London office. Two galvanometers were used simultaneously, one (called the *potential galvanometer*) for measuring the difference of potentials between the two terminals of the lamp, the other (called the current galvanometer) for measuring the whole strength of the current through the lamp. The potential galvanometer had for its coil several thousand metres of No. 50 (B.W.G.) silk-covered wire (of which the copper weighs about one-twentieth gramme per metre, and therefore has resistance of about 3 ohms per metre). Its electrodes were applied direct on the platinum terminals of the lamp. The current galvanometer had for its coil a single circle, of about 10 centimetres diameter, of thick wire placed in the direct circuit of the lamp, by means of electrodes kept close together to a sufficient distance from the galvanometer to insure no sensible action on the needle except from the circle itself. The directive force on the needle which was produced by a large semicircular horseshoe magnet of small sectional area was about 2½ c.g.s., or fifteen times the earth's horizontal magnetic force in London. This arrangement would have been better for the potential galvanometer also than the plan actually used for it, which need not be described here. The scale of each galvanometer was graduated according to the natural tangent of the angle of deflection, so that the strength of the current was simply proportional to the number read on the scale in each case. Three lamps were used, Nos. II. and III. of a larger size than No. I. The experiment was continued with higher and higher potentials on each lamp till its carbon broke. The illuminating power was measured in the simplest and easiest way (which is also the most accurate and trustworthy), by letting the standard light and the lamp to be measured shed their lights nearly in the same direction on a white ground (a piece of white paper was used); and comparing the shadows of a suitable object (a pencil was used); and varying the distance of the standard light from the white ground till the illuminations of the two shadows were judged equal. The standard used was a regulation "standard candle," burning 120 grains of wax in the hour. The burning was not actually tested by weighing, but it was no doubt very nearly right; nearly enough for our purpose, which was an approximate determination of the illuminating powers of each lamp through a wide range of electric power applied to it. The following results were obtained:—

LAMP NO. I.

No. of experiment.	Cells.	Volts.	Webers.	Volts × webers ÷ 10 = kilogram-metres.	Horse-power.	Candles	Candles per horse-power.
1	26	56·9	1·21	6 88	·093	11·6	125
2	30	65·5	1·46	9·56	·129	25	194
3	32	70 2	1·64	11·51	·156	42	263
4	33	71·8	1·74	12·48	·170	38	224
5	34	74·1	1·81	13·42	·181	44	243
6	35	76·1	1·82	13·86	·187	55	294
7	36	78·0	1·99	15·52	·210	63	300
8	37	80·3	2 06	16·54	·224	66	295
9	38	81·9	2·06	16·88	·228	76	333
10	39	84 6	2·06	17·43	·235	82	349
11	40	87·0	2·10	18·27	·247	84	340
12	42	90·9	2·17	19·72	·267	102	382
13	44	92·0	2·17	19·96	·270	89	330
14	46	99·1	2·21	21·91	·296	114	385
		Carbon of lamp broke with same power, immediately after the measurement of the light was completed.					

LAMP NO. II.

No. of experiment.	Cells.	Volts.	Webers.	Volts × webers ÷ 10 = kilogram-metres.	Horse-power.	Candles	Candles per horse-power.
1	40	89·7	2·207	19·8	·27	49	181
2	42	93·3	2 296	22·42	·29	68	234
3	43	95·4	2·38	22·71	·31	76	245
4	44	98·8	2·49	24·60	·33	101	306
5	46	103·0	2·63	27·09	·37	117	316
6	50	106·9	2·74	29·29	·40	147	367
7	52	110·8	2·85	31·56	·43	189	440
8	54	117·0	2·95	34·53	·47	196	417
9	56	119·8	2·95	35·34	·47	186	388
10	58	121·8	2·98	36 29	·49	177	361
11	40	87·0	2·14	18 62	·25	35	140
12	42	89·7	2·24	20·09	·27	42	156
13	60	122·8	3·06	37·58	·51	186	365
14	62	126·0	3·13	39·44	·53	180	340
15	66	132·4	3·24	42·89	·57	222	383
	70	Carbon of lamp broke.					

LAMP NO. III.

No. of experiment.	Cells.	Volts.	Webers.	Volts × webers ÷ 10 = kilogram-metres.	Horse-power.	Candles	Candles per horse-power.
1	40	82·3	2·85	23·45	·31	68	219
2	50	101·8	3·90	39·70	·54	195	361
3	60	Carbon of lamp broke.					

Some of the irregularities of the results in the preceding tables are very interesting and important, as showing the effect of the

blackening of the glass by volatilisation of the carbon when too high electric power came to be applied. The durability of the lamp at any particular power must be tested by months' experience before the proper intensity for economy can be determined.

On some Uses of Faure's Accumulator in connection with Lighting by Electricity, by Sir W. Thomson.—The largest use of Faure's accumulator in electric lighting was to allow steam or other motive power and dynamos to work economically all day, or throughout the twenty-four hours where the circumstances were such as to render this economical, and storing up energy to be drawn upon when the light was required. There was also a very valuable use of the accumulator in its application as an adjunct to the dynamo, regulating the light-giving current and storing up an irregular surplus in such a manner that stoppage of the engine would not stop the light, but only reduce it slightly, and that there would always be a good residue of two or three hours' supply of full lighting power, or a supply for eight or ten hours of light for a diminished number of lamps. He showed an automatic instrument which he had designed and constructed to break and make the circuit between the Faure battery and the dynamo, so as automatically to fulfil the conditions described in the paper. This instrument also guarded the coils of the dynamo from damage, and the accumulator battery from loss, by the current flowing back, if at any moment the electro-motive force of the dynamo flagged so much as to be overpowered by the battery.

An Analysis of Relationships, by Dr. A. Macfarlane.—The paper contained a summary of the notation and elementary laws of an analytical method of dealing with such questions as, in the simplest cases, may be dealt with graphically by means of the genealogical tree. The subject is a special branch of the algebra of logic, and its development appears to the author to throw much light upon the fundamental principles of that science and to suggest important questions as to the relation of mathematical analysis to ordinary languages. The method has been applied to test the "systems of affinity and consanguinity" of Dr. Morgan of Rochester, New York.

On a Microscope with Arrangements for Illuminating the Sub-Stage, by E. Crossley.—The author stated that, using a bullseye condenser, the light from the lamp is thrown into the hollow horizontal axis of the microscope, and by means of a prism placed in the centre of this axis is reflected forwards in the direction of the axis on which the swinging sub-stage turns. The arm of a swinging sub-stage is made in the form of a box, and carries a second prism on the axis, on which it moves so as to intercept the rays of light coming from the first prism, and reflect them in the direction of the arm or box. At the end of the box is a third prism, which throws the rays of light forward on to the mirror, by means of which they are finally directed to the object on the stage. No change in the position of the microscope on its horizontal axis affects the direction of the light from the lamp, and whatever the position of the swinging sub-stage, whether above or below the stage, the illumination remains constant upon the object. The greatest facility is thus given for illuminating the object at any angle, and also seeing which is most suitable. The prisms used are one-inch, and give sufficient light for a one sixteenth-inch object-glass with a Ross B-eyepiece, a suitable condenser being used beneath the stage.

Observations of Atmospheric Electricity at Kew Observatory during 1880, by G. M. Whipple.—The author having spoken about the work already done, stated that he had devised a modification of Prof. Everett's method, and had constructed a glass scale by means of which curves could be tabulated with great facility. They had commenced tabulating and discussing the accumulated records, and he was able to state some of the facts derived from the curves for 1880. Having determined the atmospheric tension for every hour during the year when measurement of the trace was possible, the diurnal, monthly, and annual variations were computed. The months of maximum tension were January and March, and of minimum tension August and September. From the year's observations it was found that the laws vary in summer and winter; for the summer months the tension was greatest with an east wind and lowest with a north wind, whilst in winter the tension was greatest with north and north-west winds and least with south-east winds. From the results obtained it was found that light winds had a higher potential than strong winds. This, however, was not well marked in summer, but is almost entirely due to winter observations.

On Prof. Phillips' Rainfall Observations made upon York Minster, by G. J. Symons, F.R.S.—The author, referring to the experiments established at York Minster, said that three gauges nearly identical in pattern were placed, one in the museum garden, one on the roof of the museum, and the third on a pole about 9 feet high placed on the centre tower of York Minster. These gauges were measured at various but identical times during the years 1832-1835, and the results were:—

	Total rain.	Ratio.
Museum garden 2 inches above ground ...	21·81 ...	100
Museum roof 44 feet ,, ...	17·39 ...	80
Minster tower 213 feet ,, ...	12·99 ...	60

Prof. Phillips stated the real amount of the diminution of rain at the upper stations depended upon the temperature of the seasons; the diminution did not vary uniformly as the square root of height, being in winter only as the cube root. Prof. Phillips' experiments soon became known, and Prof. Bache of Philadelphia set up four gauges at the angles of a square tower 162 feet high. His experiments were reported to the British Association in 1838. In 1861 Mr. Stanley Jevons made an important theoretical contribution to this investigation; he pointed out the weakness of the different extant theories, and showed that the phenomena observed were all consistent with the theory that the fall of rain was practically identical at all elevations, and that the observed differences were due to the imperfect collection by the gauges; he also stated that towers, buildings, and even the gauge itself, were obstacles to the rain-bearing current of air, and he concluded that less rain would fall on the summit of the obstacle than elsewhere, the surplus being carried forward to the lee side. Similar observations have been made during the last fifteen years, which have also been supplemented by anemometric observations, and these have proved that the difference in the amount collected was always greatest when the wind was strongest. The subject of late has been investigated by Mr. Dines, who placed several gauges 50 feet from the ground on the tower of his house. In 1877 Mr. Dines read a paper, and said that there was no actual decrease at the higher level, but a diminished collection due to eddy; he added that he found a large gauge on the tower caught much more than a small one. Mr. Rogers Field now took the matter up, and setting down the values so as to form curves he showed:—1. That the ratio of the rainfall on the tower to the rainfall on the ground depends on the force and direction of the wind. 2. That when there is no wind the rainfall on the tower is about the same as the rainfall on the ground. 3. That when there is wind the amount of rain falling on the tower will vary on different portions of the tower, the portion nearest the point at which the wind strikes the tower receiving less rain than falls on the ground, and the portion farthest from the point at which the wind strikes the tower receiving the same or more rain than falls on the ground. 4. That the excess of rain falling on the portion of the tower farthest from where the wind strikes will, to a large extent, compensate the deficiency of rain on the portion nearest to where the wind strikes, but whether to a sufficient extent to make the average amount of rain falling on the tower equal to that falling on the ground cannot be determined from these experiments. From these conclusions it is clear that if the building be flat and large, the fall in the middle of the roof ought to be nearly the same as on the ground, and in two instances this is so, first at Messrs. Marshall's factory at Leeds, and secondly Mr. Dines on a roof of 5000 square feet of area. Thus finally experimental evidence has corroborated the views of Mr. Stanley Jevons, given above.

On some of Bell and Tainter's Recent Researches and their Consequences, by W. Lant Carpenter.—The author referred to the researches of Messrs. Graham Bell and Tainter upon the sonorousness of matter under the influence of a beam of intermittent light, and described the receivers employed, in which substances are placed for examination. Porous substances gave louder sounds than dense ones, and those of a dark colour louder than light when a rapidly intermittent beam fell on them. An apparatus had been contrived by Mr. Tainter for measuring the relative sonorous powers of bodies, which was described by the author. He also stated that it had occurred to him that a modification of this apparatus might be employed for audibly estimating the relative intensities of two lights when intermittent beams fell from them upon two precisely similar receivers. The author proposed to call this instrument an audible photometer, and said that some rough experiments had somewhat justified his expectations.

On Magnetic Disturbances, by Prof. W. G. Adams, F.R.S.—The author, in considering magnetic disturbances, stated that certain facts about them had long been known; from the observations of Gauss in 1834 the disturbing power was found to increase in northern latitudes; it was also found that the appearance of a disturbance occurred in several places at the same instant, but with great differences of results. The force seemed to originate at a certain point in the interior of the earth, and the direction of the disturbing force seemed constant, yet great differences were observable at places not remote from one another. Sabine found that these disturbances had daily and yearly variations from their mean values, and that they have an eleven-year period corresponding to the appearance of spots upon the sun. It has been shown by observations that magnetic disturbances and electric currents on the earth are related; these electric currents in the earth have commonly been attributed to changes of temperature. The month of March, 1879, was chosen for a comparison of the photographic records of magnetic disturbances, and records for the whole month were sent from Lisbon, Coimbra, Stonyhurst, Vienna, St. Petersburg, and Bombay in the northern hemisphere, and from Melbourne and the Mauritius in the southern hemisphere. Taking the disturbances on March 15–16, 1879, as an instance, we see that soon after 10 a.m. Greenwich time on the 15th, a disturbance-wave happens, which shows first a diminution and then an increase of horizontal force at St. Petersburg, Vienna, Kew, and Lisbon, and also at Melbourne in Australia. At 9.30 p.m. of the same day a magnetic storm begins, and continues for about an hour. It is felt in the northern and southern hemispheres. At all stations in Europe the horizontal force is increased in the first part of the storm, and then diminished. At Lisbon the vertical force is first increased and then diminished, and at St. Petersburg and Stonyhurst there is a diminution in the vertical force at the same time as at Lisbon. Regarding the declination needles, we find that at St. Petersburg, Melbourne, and Bombay the declination westward is first increased and then diminished, whereas at Kew and Lisbon the motions are in opposite directions. At Bombay and Mauritius, near to, but on opposite sides of, the equator, the declination needles are deflected opposite ways. If we assume that by magnetic induction the earth's magnetism is altered, the position of the magnet which would cause the disturbance must be such that its pole, which attracts the marked end of our needle, must lie at the beginning of the disturbance to the east of Kew and Lisbon, to the north of Vienna, and to the north-west of St. Petersburg; the Lisbon vertical force curve also shows it to be below the surface of the earth. Hence an inductive action equivalent to a change of position of the north magnetic pole towards the geographical pole would account for these changes. The strengthening and weakening of a magnet with its north pole to the north on the meridian of Vienna might account for magnetic changes observed between 9.30 and 10.30 at night, Greenwich time, on March 15, 1879. In attempting to explain this disturbance by currents of electricity or discharges of statical electricity in the air above the needles, we must imagine that at first there is a strong current from the south-west over St. Petersburg, from the west over Vienna, and from the north-west over Kew and Lisbon, the vertical force needle at Lisbon showing that the current from the north-west lies somewhat to the east of Lisbon; that at the Mauritius this current is from the north, and at Bombay from the south. Thus we must imagine that a current of electricity passes down from the north-west to the south-east, going on towards the east over Vienna, and towards the north-east over St. Petersburg. This must be kept up very much along the same line throughout the first part of the disturbance, and then the current must be altered in strength in the same manner at all stations. An examination of the principal disturbances at Kew and at St. Petersburg seems to show that (1) a diminution in the horizontal force is accompanied by greater easterly deflections of the declination needle at St. Petersburg than at Kew; (2) increase of horizontal force is accompanied by greater westerly deflections at St. Petersburg than at Kew, or is sometimes accompanied by a westerly deflection at St. Petersburg and an easterly deflection at Kew. Only moderate disturbances have already been considered, and the author now treats of a much larger magnetic storm which began at 10.20 a.m. Greenwich time on August 11. This storm may be divided into three storms: one lasting from 10.20 on the 11th to 1 a.m. on the 12th; a second from 11.30 a.m. on the 12th to 7.20 a.m. on the 13th; and the third from 11.50 a.m. on the 13th to 7 to 8 a.m. on the 14th of August. The first storm began on August 11, at the same instant at all stations. There is a decided similarity, especially in the horizontal force curves, throughout the first part of this storm, and certain points in it stand out prominently. The deflections are alike at Lisbon, Kew, Vienna, St. Petersburg, and after the first very sudden deflection at Toronto also. The greatest effect is produced at St. Petersburg; the similarity between the large disturbances at Vienna and Toronto, in Canada, places differing about six and a half hours in time, is remarkable. About 11.45 p.m. and 2.40 p.m. there are very remarkable points of agreement. From about 4.30 p.m. to 8 p.m. Greenwich time, *i.e.* from about 11 a.m to 2.30 p.m. Toronto time, the deflections are opposed at Toronto and at Vienna or Kew. This would point rather to solar action as the cause of the disturbance. At 9 p.m. the disturbances are all in the same direction, but about 11 p.m., whilst St. Petersburg agrees in direction with the others in a very violent phase of the storm, at Toronto the direction of the deflections is reversed, and this reversal of curves continues until about the end of the first of the three storms. The second storm, the most remarkable of the three, began about 11.30 a.m. on the 12th, and lasted until the next morning. At Toronto the line goes off the edge of the paper on which the photographic record is taken. At Vienna and Melbourne the motion is so rapid that the plate is not sensitive enough to receive the impressions. At 12.20 midday, the time of greatest disturbance at Lisbon and at Zi-ka-Wei near Shanghai in China, two places nine hours different and nearly in the same latitude, the vertical force is increased in precisely the same fashion. At St. Petersburg the change in the horizontal force was one thirty-fifth part of the whole horizontal force, and the total force was changed to about one-eightieth part of its full value. These magnetic changes are so large as to be quite comparable, as we see, with the earth's total force, so that any cause which is shown to be incompetent from the nature of things to produce the one can hardly be held to account for the other.

The number of mathematicians who attended the meeting was very remarkable, and among the foreigners present may be mentioned Messrs. Halphen, Chemin, Rudolf Sturm, Cyparissos Stephanos, and W. Woolsey Johnson (Annapolis, U.S.). A separate mathematical department was formed, which met on three days, and more than thirty papers on pure mathematical subjects were read, many of them being of great interest. Prof. Halphen made a communication on Steiner's theorem relative to the positions of the centres of conics passing through three given points, and gave an elegant extension of the theorem to distinguish the cases in which the three points lay on the same or opposite branches of the curve. He also made communications on the subject of linear differential equations and hypergeometrical series; and in a fourth paper he considered the number of aspects in which points in a plane may be viewed. He showed that two points may be thus viewed in six ways, that four points can be viewed in nine ways, and illustrated this by a diagram, and extended the theorem to five points. Prof. Sturm communicated an elaborate memoir on curves of double curvature, relating to the researches of Cayley and Halphen, which was ordered to be printed *in extenso* among the reports. M. Stephanos read several papers, in one of which he showed that the different homographies which exist upon a straight line, and which are triply infinite in number, may be identified with the points of space. A simple and beautiful representation of the particulars of these systems was thus obtained.

The other papers included communications by Prof. Cayley, *On the Transformation of Elliptic Functions, and on Abel's Theorem*; by Prof. H. J. S. Smith, *On the Differential Equations satisfied by the Modular Equations, and on the Theory of the Multiplier in the Transformation of Elliptic Functions*; by Mr. J. W. L. Glaisher, *On the q-Series in Elliptic Functions*; by Dr. Hirst, *On Consequences of the Second Order and Second Class*; and by Prof. R. S. Ball, *On the Application of non-Euclidean Space to a Problem in Kinematics, and an Extension of the Theory of Screws to the Dynamics of any Material System.*

SECTION B—Chemical Science

The Present State of Chemical Nomenclature, by Prof. A. W. Williamson, Ph.D., F.R.S.—The author stated there were perhaps few departments of science in which such definite principles had been adopted, and to a great extent this applied to the

formation of names, as in their own science of chemistry. The practice of stating in a name as briefly as possible certain facts, and as a rule important facts, had been, as every chemist knew, the chief object of their nomenclature. But he thought he might be permitted to say that if one looked to the composition of any result like the present nomenclature of chemistry—which had been guided by intellectual principles—it was of immense importance to consider its purely intellectual principles, viz., the principles of convenience, and perhaps even of popular tastes, and, if he might be allowed to imagine such a thing, even the prejudices which occasionally arose among a great number of men who adopted any particular form of expression. He proposed to refer to the question from the different points of view. If they had occasion to consider, without knowing anything about it, what was the most important condition to which every name ought to conform, he fancied there would be no two opinions on the matter. The first and most important condition and requirement of every name of a thing that was important was that it should call to the minds of those who used it, without ambiguity, some one particular thing or one particular idea. He should be inclined to consider a code of laws by which their action would be rendered uniform with regard to names, and which would establish such fundamental principles that an absence of ambiguity would be secured. The more any name could be defined and shortened the better it would be for chemistry. In the modern progress of chemistry, especially in that department of which the growth had been enormously great—he meant the many carbon compounds—the purpose of obtaining clearness and avoiding ambiguity in the nomenclature had been, with few exceptions, satisfactorily attained. But he thought members would agree with him that in the names given to some compounds more complex than others the chief object of convenience had not been attained to an equal extent. They found names given which, when carefully considered by chemists, told a story, but a very long story, and in a manner which was really free from ambiguity, but only by aid of a great number of syllables, and a compound word of inconvenient length was this attained. On the other hand, amongst very common substances that systematic process had been, he thought, to a considerably less degree adopted. The older names of commoner substances, such as salts, were to a great extent based upon facts which were true, but were by no means the only facts to be recalled. Of course every chemist knew the great number of names that were in common use, and how far they served to recall a particular process, but only one among many processes by which the substance could be formed. On the other hand, many names had grown up from bodies which were purely empirical—names which did not recall any particular properties, but served with great convenience and without ambiguity to indicate the body. If they looked to the circumstances which affected that one condition which he had submitted as essential to names being perfectly free from ambiguity, there was perhaps hardly one condition more practically important than this, that there should be in the names as little change as possible, and more especially was this the case when a name that had once been given had come to be used in relation to particular substances. It was within the memory of chemists that changes of name had taken place not only when a particular substance was recalled, but there were also a considerable number of cases showing that the name given at one time to one body was afterwards given to another. The circumstances attending such changes were in some instances of an exceedingly reasonable kind, and well worthy of consideration after it was found that there were grounds for believing that the names belonged more properly to other substances. If, however, changes introduced confusion, they were necessarily injurious to the progress of the science. When he looked back to the successive steps by which their knowledge had risen to its present position, and to the ideas that had succeeded one another, he felt that in order to really understand chemistry, and to be able to arrange the facts in a convenient order, they must see how they had grown up. If that was important in practical matters, it was even more important in what he might call the scientific work. He ventured to think, at all events he had always felt, that to use with safety any idea that they were accustomed to use, it was almost essential, and was certainly of importance, that they should endeavour to trace the origin and growth of that idea, so as to see what it really meant. His object in bringing the subject before the Section was to obtain from his colleagues and friends their views on the present state of matters, and to give them the opportunity of considering together—those who more especially felt it their duty to contribute by any means in their power to the advancement of science either in guiding the operations or growth of those names—whether there could not be greater concert among chemists as to what was being and what had been done, so that they might conform their doings to certain laws. He had frequently seen with regret some features in chemical nomenclature that had been springing up of late years. He had seen some habits gaining ground which appeared to be at variance with the best principles of nomenclature—he would assume such to be the case. But there were laws in the growth of those words, and he could not doubt for his own part that if chemists came to recognise those laws, or rid themselves of them, the future growth of words would gradually come to be a more systematic guide. It had sometimes been felt that to attempt to solve the problem would be useless, and that irregularities had become so prevalent that it would be hopeless to think they could ever remedy them. But he thought differently, and would urge that in the direction he had pointed out they were only now beginning to move. There was only one convenient division among names. That division, of course, was not absolute, because no such division could be absolute; but the great majority of names were used to denote things and ideas. Some names were of little use in relation to the particular ideas, and therefore it seemed to him that the best way to obtain a name was as the result of experiment. If founded on that principle there could be no ambiguity. At the present time, as their views had considerably changed, and as they had not attained finality in their operations, there was much to be learnt, and it was reasonable to suppose that if they adopted a particular name to indicate a particular thing it might perhaps turn out at some time hence an error upon which people would look back as historical. With regard to names, especially theories, there were some of them that had certainly served important purposes. It was then really essential to the arrangement of their ideas that they should for the time imagine something to exist, and that they should recall by some convenient name that which they assumed or imagined. Names, in his opinion, ought to express ideas; but there were many names introduced which he thought were used for no better purpose than to express the absence of ideas. It often happened that when exploring any particular part of a field, they got a rational clue which led them clearly and well for a certain way; and they failed to follow it further. The cases were numberless, but one of the most important was that of chemical combination itself. Complex bodies were far more numerous than the few simple bodies with which they had to do, and while in the habit of using the term chemical combination, they had concealed their ignorance of the state of combination. Others used the term molecular combination, and there again they concealed their ignorance of the bodies to which it was applied. Among the present anomalies in names there was one which he ventured to submit to the consideration of the Section, and which had grown up to some extent of late, and that was the replacing of empirical names of things by names, which, while he would call them rational, because they served to recall intelligibly and without ambiguity, served to recall the number of atoms. He mentioned such cases by way of illlustrating the ractice which had seemed to him to be gaining ground of late years, for the purpose, as some said, of increasing the clearness of statement. He had no doubt that the words were framed for the purpose of conveying to the mind something useful to know, and as names formed on that principle had been found to be based on those superseded by others, he thought when they came to such names as indicated molecular composition it was better to avoid them, because, as he had said, they had not arrived at finality. The chemists of fifty years ago were as confident as chemists of the present day in the matter of nomenclature; and therefore the more they could obtain names without ambiguity and without liability to change in the future, the more probable was it that such names would stand and continue to be used. A crowd of material presented itself just then to his mind, but he did not think it would be well to trouble the Section with further remarks. He merely wished to throw out the ball for his colleagues to deal with.

Cellulose and Coal, by C. F. Cross, B.Sc., and E. J. Bevan.—This is a continuation of the authors' researches on bast fibre (Chem. Soc. *Journ.*, 1880, abstr. 666). By the action of sulphuric acid (sp. gr. 1·65), at 70°, on jute fibre, an insoluble, black, spongy substance has been obtained; that the cellulose

of the fibre contributes to the formation of the substance, is shown by the formation of a similar compound from pure cellulose and dextrin. A chlorinated product ($C_{20}H_{16}Cl_4O_{10}$) has been obtained from this black substance, its properties are similar to those of the aromatic substance described in a previous paper (*loc. cit.*). The production of this spongy substance is usually a destructive one, and attended with an evolution of CO_2 and the production of acetic acid, &c. It is not, however, necessarily so, for when the action of the sulphuric acid is arrested before the evolution of carbonic dioxide, a reddish brown solution is obtained, from which when poured into water a copious flocculent precipitate is obtained, of a body very similar in chemical properties to the black substance described above. The chlorine substitution products are easily converted into astringent bodies, producing dark-coloured precipitates with iron salts and copious coagulation with gelatine. These facts, together with the following:—(*a*) Meissner and Shepard's conclusion that the hippuric acid of herbivorous urine is derived from an aromatic body present in the fodder, apparently a form of cellulose, which the authors have identified as similar to the characteristic consituent of bast fibre; (*b*) the previous demonstration by the authors of the homogeneous nature of jute fibre, and that in its resolution the percentage yield of cellulose may be increased apparently at the expense of the aromatic constituent; (*c*) that the process of liquification (or the formation of tannin-like substances) is said by microscopists to be due to an intrinsic modification of the substances of the cell-walls, *i.e.*, of the cellulose, and not to an infiltration of the substances present in the cell cavity; (*d*) the numerous cases in which tannic acid is formed at the expense of plant structures of the nature of cellulose—lead the authors to conclude that, until the contrary is proved, lignin must be regarded as derived from cellulose by chemical modification. The spongy black substance, previously described, dries to a hard mass resembling cannel coal, with which the authors have compared it, and have obtained similar products of chlorination and nitration, and further support of the opinion that coal is not carbonaceous in any more special sense than alcohol, but is rather, as supposed by Balzer, composed of C, O, H, N bodies, which are genetically, if not homologously related. The authors suggest that cellulose, lignite, peat, lignin, and anthracite are terms of an infinite series differentiated under the conditions of their formation.

Hydration of Salts and Acids, by C. F. Cross, B.Sc.—The method adopted by the author for investigating the rate of hydration of a substance consisted in exposing about 1 gramme of the substance in a bell-jar of 2000 c.c. capacity, to an atmosphere saturated with aqueous vapour. After a critical investigation of the probable errors, the "Jolly" Federwaage was used to make the numerous weighings required, and thus the method of observation was rendered very expeditious. The paper contains diagrams representing the velocities of hydration for certain salts and oxides. The author has observed that, under these "artificial" conditions of exposure, all the soluble salts examined deliquesce. This takes place in some cases without previous hydration, *e.g.*, with potassium bichromate, and in such cases the water may be removed by pressure between blotting paper. In other cases, *e.g.*, with $CuSO_4$, the salt deliquesces after uniting with water of chemical hydration, and in a different manner. It would therefore appear that the continuity of the phenomena of hydration and solution, as regards the determining cause, is demonstrated by these observations.

On Colliery Explosions, by W. Galloway.—The author gave an account of his experiments made to show the influence of coal-dust in colliery explosions. In July, 1878, he made three sets of experiments with different kinds of apparatus. In the first set, in which coal-gas was used instead of fire-damp, and the gas and air were carefully measured, and then coal-dust added, it was shown that 2 per cent. of gas, mixed with air, was rendered inflammable when coal-dust was added; 3 per cent. of gas made this mixture slightly explosive; 4 per cent. made it still more explosive; and 5 per cent. produced a violent explosion. The total quantity of gas and air mixture was little more than a cubic foot. In the second set it was shown that the return air of a mine containing 2 per cent. of fire-damp became inflammable when coal-dust was added to it. In the third set the explosion of a mixture of air and fire-damp was made to raise and ignite coal-dust scattered along the floor of an artificial gallery 70 or 80 feet long, and 14 inches square inside. The flame of the fire-damp explosion alone was found to be 7 feet or 8 feet long; the flame of coal-dust in pure air was 35 feet or 40 feet long; and the flame of coal-dust in the return air employed in the first set of experiments was 80 or 90 feet long. The publication of the e results called further attention to the subject, and after the Seaham explosion the Home Secretary requested Dr. Abel to inquire, amongst other things, into the influence of coal-dust in promoting that disaster. Prof. Abel made experiments near Wigan, and obtained results similar in kind to the author's, but different in some respects. In July of the present year the author made experiments with apparatus of the following description: A sheet-iron cylinder 6 feet long by 2 feet in diameter, closed at one end and open at the other, had its open end bolted to a wooden gallery 126 feet long by 2 feet square inside. One end of the wooden gallery was thus closed by the sheet iron cylinder, an explosion chamber, and the other end was open. Six sheets of newspaper were placed between this open end of the explosion chamber and this gallery, and a tight joint was ensured by means of screws. Rather less than 2 cubic feet of fire-damp was carefully measured and introduced into the explosion chamber. The wooden gallery contained only pure air. The air and fire-damp contained in the explosion chamber was thoroughly mixed by means of an appropriate mechanical arrangement, and the mixture was exploded. The explosion burst the sheets of paper, and the resulting flame travelled about 12 feet or 14 feet along the gallery, and as suddenly disappeared. The gallery was then strewed with a layer of the coal-dust from ⅛ inch to ¼ inch thick along its floor, and some was placed on shelves which stood in sets of three, one above the other, at distances of 10 feet from each other, along the gallery. The same arrangement as before was then made in regard to preparing for a fire-damp explosion, exactly the same quantity of fire-damp being measured, mixed, and exploded. By this explosion of the fire-damp mixture the coal-dust was raised in a cloud throughout the whole length of the gallery, part of it was projected out into the air to a distance of 20 feet or 30 feet beyond the end, and, after the lapse of an appreciable interval of time, the flame found its way to the end of the gallery and flashed out through the cloud of dust to a greater or less distance according to circumstances. The greatest length of flame thus obtained with coal-dust and pure air was 147 feet on one occasion, and from 100 feet to 140 feet very often. He considered that these results proved in the most convincing manner that coal-dust formed an inflammable mixture with pure air, and they settled once for all the question as to how an explosion in one district of a dry and dusty mine could penetrate to the most distant parts of every other district of the workings in the same mine. In conclusion the author spoke of the necessity of keeping the floors of mines damp, and thus lessening the dangerous influence of coal-dust.

SECTION C—GEOLOGY

A preliminary Account of the Working of Dowkerbottom Cave in Craven during August, 1881, by E. B. Poulton, M.A., F.G.S.—Dowkerbottom Cave is 1250 feet above the sea, between Arncliffe and Kilnsey. Its mouth is merely a fall in the roof of the cave, which stretches from either end of the fissure thus formed. The original mouth is not now visible, but is probably to be found at the foot of a slope to the south. During most of its course the chambers and passages of the cave are not separated by any great thickness of rock from the ground above, and thus other falls must be expected to occur. The eastern division of the cave is about 450 feet long, and has three fine chambers separated by two passages, the first very short, and the second very long. This division ends under high ground, and the true mouth must be in the other, or western cave. The last chamber is characterised by mechanical deposits—blocks of limestone fallen from the roof and a stiff brown clay beneath. In the other chambers and passages are chemical deposits—hard and soft stalagmite. The western division is smaller, but also contains three chambers and two passages. It must be about 250 feet long. Chemical deposits, with some falls from the roof, are present throughout. In former workings by Mr. Farrer, Mr. Denny, and Mr. Jackson, the first chambers were explored in their surface layers at least, and here were found the numerous metal and bone ornaments and implements, together with the bones of animals usually found in the historic layers (of Romano-British age) in caves. The second passages have also been worked, and part of the second chamber on the eastern side. Other parts of the cave appear to be quite untouched. The great

difficulty in working the cave is the removal of the *débris* to prevent its interfering with further work. We therefore put up a windlass over the eastern entrance and cleared a way for barrows through the talus below. Beneath the talus the black earth, in which remains had been previously found, was seen, and many articles of Roman age were taken from it. Chamber III. was marked into parallels, and these into squares. In the centre we sank a shaft and passed through the following layers:—(1) *Romano-British layer*, a black earth with pottery, ornaments, &c., and numerous bones, usually from 1 to 2 inches thick; (2) *hardish stalagmite*, about 6 inches thick, in one place containing the bones of a dog or small wolf; (3) *soft stalagmite* 4 inches thick; (4) *hardish stalagmite* 6 inches thick; (5) *soft stalagmite* 2 feet 6 inches thick; (6) *stiff brown clay* with large angular blocks of limestone fallen from the roof firmly imbedded in it. This layer was 8 feet deep, as far as we saw it. The last two feet are laminated and contain smaller blocks. At the depth of about 12 feet from the surface we came upon part of the solid limestone floor or side of the cave, sloping steeply downwards. There were no indications of a change in the nature of the deposit at the junction with the limestone, and the clay appears to extend much deeper than the level at present reached. Thus below the stalagmite purely mechanical deposits succeed, and no limestone blocks are found above this horizon, although the stalagmite has been removed over a large part of the floor of the chamber. No traces of a fauna have been as yet found below the first hardish stalagmite; indeed all the deposits passed through below the stalagmite indicate the former presence of a still lake in which the great thickness of clay slowly accumulated. Further work was stopped by the heavy rain which flooded the shaft dug in the clay. It is interesting to note that the former condition of Chamber II. is identical with the present state of the third chamber in the preponderance of mechanical over chemical deposits. The change from mechanical to chemical deposits was probably produced by a change from accumulation in still water to accumulation in running water. Possibly also the absence of blocks fallen from the roof in the stalagmite may be due to the bicarbonate of lime contained in the water which percolated through the roof, cementing together the limestone blocks. The absence of this cement when the clay was deposited may be due to the absence of solvent power in the water which then percolated through the roof. For the carbon dioxide would not be evolved from a soil deficient in organic matter, as the soil covering the Yorkshire hills for a period long after the Glacial period must have been. The author expresses his best thanks to Mr. J. R. Tennant of Kildwick Hall, Leeds, and to Mr. J. R. Eddy of Carleton, Skipton, who gave, on behalf of the Duke of Devonshire, the permission to work the cave, and further aided with kind help and advice all through the work.

On Asteromiha Readi, a New Species of Coral from the Oligocene of Brockenhurst, by Prof. P. Martin Duncan, F.R.S.—The author described the characters of this coral, placing it in the genera established to include certain corals from the West Indies, and some dredged up in the Carribean Sea by Count Pourtalès. He referred to the genus Madrepora, which lives in twenty to twenty-five fathoms, 74° Fahr. temperature, reef-building coral, or on banks in a turbulent sea. The specimens are generally rolled, but some are absolutely perfect, and clearly give the history of the physical conditions of the close of the Eocene period in the south of England, which then resembled the climate of the Bermudas.

On the Formation of Coal, by E. Wethered, F.G.S., F.C.S.—The author considers (1) that coal was not formed from vegetation of the Lepidodendroid type, and that therefore the Stigmaria found in the underclays are not the roots of the vegetation which gave rise to the coal; (2) that the varieties of coal and the change which sometimes takes place in one and the same seam are not due to metamorphism, nor are they dependent upon the contorted state of the surrounding strata, but arise from the greater or less chemical decomposition of the vegetable mass, influenced by the circumstances under which it was submerged. On the land grew the vegetation of the period, represented by the Lepidodendrons, Sigillaria, Calamites, &c. As the land sank and the waters encroached, the land vegetation was gradually washed away, but the roots remained in many cases, and those which offered the greatest resistance to decay are the ones preserved in a fossil state—hence the occurrence of Stigmaria. As the waters advanced the ground would become swampy, and then we might expect to see spring up reeds, mosses, and other vegetation suitable to the changed condition; it is to vegetation of this kind that the author ascribes the formation of coal. With a view of ascertaining whether the chemical composition of the beds which overlie a seam of coal which has changed from bituminous to anthracite also changed, the Welsh "nine-feet" seam was selected, which near Cardiff is semi-bituminous, and at Aberdare becomes anthracite. Specimens of the overlying strata were selected from the two districts at each foot above the coal for five feet; these were analysed, and it was found that the beds from near Cardiff were considerably more argillaceous and, as a whole, less ferruginous than those at Aberdare.

On the Palæozoic Rocks of North Devon and West Somerset, by W. A. E. Ussher, F.G.S., Geological Survey of England and Wales.—The classification adopted is as follows:—

LOWER DEVONIAN	FORELAND GRITS	Red and purplish grits, fine-grained, and in places siliceous.
	LYNTON BEDS	Grey, even-bedded, and jointed grits, grey schists, and schistose grits with films of calcareous matter.
MIDDLE DEVONIAN	HANGMAN GRITS	Coarse white quartzose, red-speckled grit, in and upon red and grey rather fine-grained grits associated with shaly and slaty beds.
	ILFRACOMBE SLATES PASSING INTO MORTE SLATES	Grey and silvery slates and shales with arenaceous films, and impersistent bands of limestone passing into pale greenish unfossiliferous quartzose slates.
UPPER DEVONIAN	PICKWELL DOWN BEDS	Indian-red slates upon red, green, and grey grits, with local purple slate basement-beds passing into the Morte slates.
	BAGGY BEDS	Green slates with *Lingula*; brown micaceous grits with *Cucullæa*, positions of these horizons apparently reversed near Wiveliscombe.
	PILTON BEDS	Bluish and greenish grey argillaceous slates, with occasional thin films of limestone and masses of grit (as at Braunton, &c.).

The Foreland Grits occupy an area (superficial) of thirty square miles, extending from Countesbury to Dunster. The Hangman Grits form the range which includes Dunkery Beacon, also the whole northern part of the Quantocks. Their relations to the Ilfracombe Slates are much complicated by faults around Croydon Hill and on the Quantocks; and the prevalence of grits in the Ilfracombe series, whilst indicative of lithological assimilation, makes the boundary rather indefinite.

On the Characters of the "Lansdown Encrinite" (*Millericrinus Pratii*, Gray, sp.), by P. Herbert Carpenter, M.A.—The "Lansdown Encrinite" is a species of *Millericrinus* (*M. Pratii*, Gray, sp. = *Apiocrinus obconicus*, Goldfuss) from the Great Oolite on the top of Lansdown, near Bath. It is remarkable for the very great variation in the characters of its stem and calyx. The former may reach 50 mm. in length, and consist of seventy discoidal joints; or there may be less than ten joints, the lowest of which is rounded off below, and its central canal closed up. Various intermediate conditions may occur between these two extremes, while in some specimens there may be only two to four stem-joints; and in one case the whole stem is represented by a slightly convex imperforate plate on which the basels rest. This specimen, taken by itself, would be naturally regarded as a *Comatula* of advanced age, in which the cirrhus-sockets had disappeared from the centre dorsal just as they do in the recent *Actinometra Jukesii*. The general appearance of the calyx is very similar to that of *Pentacrinus Wyville-Thomsoni* from the North Atlantic. But it is remarkable for the number of small intercalated pieces which it may contain. The basels are frequently separated from one another, or from the radials, by minute plates which, while regularly developed all round the calyx in some specimens, are entirely absent in others. The nearest allies of *M. Pratii* seem to be *M. Munsterianus*, var.

Buchianus and *M. Nodotianus*. It stands on the extreme limit of the genus, connecting it with *Pentacrinus* on the one hand, and with the free *Comatulidæ* on the other. It is thus a synthetic type, as would naturally be expected from its geological position; for it is probably the earliest known species of the genus, except perhaps for two doubtful Liassic forms, which are known only by isolated plates and stem-joints.

Observations on the two Types of Cambrian Beds of the British Isles (the Caledonian and Hiberno-Cambrian), and the Conditions under which they were respectively Deposited, by Prof. Edward Hull, LL.D., F.R.S.—In this paper the author pointed out the distinctions in mineral character between the Cambrian beds of the North-West Highlands of Scotland, and their assumed representative in the east of Ireland and North Wales. In the former case, which included the beds belonging to the "Caledonian type," the formation consists of red or purple sandstones and conglomerates; in the latter, which included the beds belonging to the "Hiberno-Cambrian type," the formation consists of hard green and purple grits and slates, contrasting strongly with the former in structure and appearance. These differences, the author considered, were due to deposition in distinct basins, lying on either side of an archæan ridge of crystalline rocks, which ranged probably from Scandinavia through the central Highlands of Scotland, and included the north and west of Ireland, with the counties of Donegal, Derry, Mayo, Sligo, and Galway, in all of which the Cambrian beds were absent, so that the Lower Silurian repose directly and uncomformably on the crystalline rocks of Laurentian age. As additional evidence of the existence of this old ridge, the author showed that when the Lower Silurian beds were in course of formation the archæan floor along the west of Scotland must have sloped upwards towards the east, but he agreed with Prof. Ramsay that the crystalline rocks of the Outer Hebrides formed the western limit of the Cambrian area of deposition, and that the basin was in the form of an inland lake. On the other hand, looking at the fossil evidence both of the Irish and Welsh Cambrian beds, he was of opinion that the beds of this basin were in the main, if not altogether, of marine origin, and that the basin itself had a greatly wider range eastward and southward, the old archæan ridge of the British Isles forming but a small portion of the original margin.

On a Discovery of Fossil Fishes in the New Red Sandstone of Nottingham, by E. Wilson, F.G.S.—The author called the attention of the Section to a recent discovery of fossil fishes in the Lower Keuper Sandstone of England—a circumstance of sufficient rarity in itself, apart from any palæontological results, to deserve at least a passing notice. During the construction of the Leen Valley Outfall Sewer in 1878, a remarkably interesting section was given by the tunnelling driven through Rough Hill, or Colwick Wood, near Nottingham, showing the lower beds of the waterstones resting on a denuded surface of the "Basement Beds" of the Keuper. The lowest stratum of the waterstone was a sandstone about a foot thick, with streaks of red and green marl, and a seam of pebbles at the base. The fishes occurred in this bed, and chiefly in a thin seam of red marl overlying the pebbly seam at the very bottom of the Waterstones; they were present in large numbers, as if in a shoal, for a distance, in the line of section, of about thirty-three feet. The specimens obtained have been examined by several competent authorities, but unfortunately their state of preservation is so bad that nothing certain can be made out as to their precise zoological affinities. Dr. Traquair, however, believes that they probably belong to some species, new or old, of the genus *Semionotus*.

Glacial Sections at York, and their Relation to the later Deposits, by J. Edmund Clark, B.A., B.Sc., F.G.S.—The York area chiefly consists of glacial beds, which form the high ground and various extensive low tracts more or less remote from the Ouse. Glacial depressions have been filled up with brick-earths, and, in exceptional cases, peat-beds. Where the river channel is narrowed below the city, the crests of the banks are capped with gravels. The peat-beds of Campleshon Pond and part of St. Paul's Square rest on the levels covered with brick-earth. Near Ouse Bridge a peat-bed 50 feet down, at Bratt's Brewery, has been called interglacial; but the beds above it cannot positively be asserted to be glacial; for at the waterworks similar beds appear, in which plant-roots were detected 20 feet down. The following sequence of the beds can be established:—

Brick-earths.—At the Harrogate Signals, a quarter of a mile further north, the junction of the upper beds with glacial (or probably glacial) beds is seen. At a few points bosses of boulder clay protrude even here through the upper beds, whilst elsewhere depressions are filled with brick-clays, now extensively worked.

Gravels.—The gravel beds at Fulford and on the opposite side of the Ouse are much alike. The beds are irregular, roughly stratified, with boulders of a quarter-ton weight. The stones are precisely the same as those in the boulder clay; some limestone boulders are still striated. At the gravel pits now being worked on the Bishopthorpe Road a metatarsal of *Ursus spelæus* (or *U. arctos*) was found this spring. There seems to be no previous record of any carnivorous remains from this neighbourhood.

Glacial Sections.—The *deepest* glacial sections were some made in drainage-work at the Friends' Retreat, in 1876, a drift, 650 feet long, cutting through the hill from north-west by west to south-east by east. At the highest point this was 47 feet below the surface. Shafts were sunk every 50 feet. Nothing but glacial beds were met, tough boulder clays, gravelly beds, and sand-beds. The latter were variously inclined and much cut up, rarely continuing any great distance. Indeed everything pointed to the whole mass being made up of independent parts, heaped and piled against each other. The largest boulder brought up weighed about 600 pounds, which is as much as any seen near York *in situ*, except, possibly, one still to be seen on the Mount. Some of those in the museum grounds must weigh more. Among other stones two lumps of coal were brought up. The most extensive series of sections are those on the site of the New Goods Station. For this a level was obtained four acres or so in extent, and 3 to 12 feet below the old surface. Unfortunately there are no records of the sections made in this part. The stones found, though including many from the Lake District, chiefly come from the Carboniferous beds of the West Riding. Limestones are usually scratched and often beautifully polished. At all the places mentioned occasional specimens occur from Lias and Oolite beds, so that an easterly drift must have sometimes counteracted the prevailing set from the west. These glacial beds approach nearest to the purple boulder clay of Messrs. Searles V. Wood and Harmer. Floating ice, however, rather than the *moraine profonde* of an ice-sheet, seems best to account for the mixture of tough boulder-clays with beds of boulders, gravels, and current-bedded sands. The post-glacial deposits are worked to depths of 30 feet and more; in the river-bed they may exceed 50 feet. The river is now 60 or 70 feet above its pre-glacial bed, and probably 40 or 50 above the level to which it first cut down in the opening of the post-glacial epoch.

The Devono-Silurian Formation, by Prof. E. Hull, LL.D., F.R.S., &c.—The beds which the author proposed to group under the above designation are found at various parts of the British Isles, and to a slight extent on the Continent. The formation is, however, eminently British, and occurs under various local names, of which the following are the principal:—

ENGLAND AND WALES

Devonshire.—"The Foreland Grits and Slates," lying below the Lower Devonian beds ("Lynton Beds").

Welsh Borders.—"The passage beds" of Murchison, above the Upper Ludlow Bone bed, and including the Downton Sandstone, and rocks of the Ridge of the Trichrug. These beds form the connecting link between the Estuarine Devonian beds of Hereford (generally, but erroneously, called the "Old Red Sandstone") and the Upper Silurian Series.

South-East of England (Sub-Cretaceous district).—The author assumed, from the borings at Ware, Turnford, and Tottenham Court Road, described by Mr. Etheridge, that the Devono-Silurian beds lie concealed between Turnford and Tottenham Court Road on the south, and Hertford on the north.

IRELAND

South.—"The Dingle Beds," or "Glengariff Grits and Slates," lying conformably on the Upper Silurian beds, as seen in the coast of the Dingle promontory, and overlaid unconformably by either Old Red Sandstone, or Lower Carboniferous beds, 10,000 to 12,000 feet in thickness.

North.—"The Fintona Beds," occupying large tracts of Londonderry, Monaghan, and Tyrone, resting unconformably on the Lower Silurian beds of Pomeroy, and overlaid unconformably by the Old Red Sandstone, or Lower Carboniferous beds, 5000 to 6000 feet in thickness.

SCOTLAND

South.—Beds of the so-called "Lower Old Red Sandstone" with fish and crustaceans, included in Prof. Geikie's "Lake Orcadie, Lake Caledonia, and Lake Cheviot," underlying unconformably the Old Red Sandstone and Lower Calciferous Sandstone, and resting unconformably on Older Crystalline rocks. Thickness in Caithness about 16,200 feet. The author considered that all these beds were representative of one another in time, deposited under lacustrine or estuarine conditions, and, as their name indicated, forming a great group intermediate between the Silurian, on the one hand, and the Devonian on the other. He also submitted that their importance, as indicated by their great development in Ireland and Scotland, entitled them to a distinctive name, such as that proposed.

On the Discovery of Coal-Measures under New Red Sandstone, and on the so-called Permian Rocks of St. Helen's, Lancashire, by A. Strahan, M.A., F.G.S., Geological Survey of England and Wales.—The Trias has been penetrated, during the last few years, by three colliery shafts and three boreholes in the district bordering the St. Helen's and Wigan coal-fields on the south. It was thinner than might have been expected, while the Permian formation was altogether absent. This latter formation was believed to underlie the Trias, but to be overlapped, so as not to appear at the surface, excepting at St. Helen's Junction, where a marl-bed, and a soft sandstone beneath it, 30 and 90 feet thick respectively, and supposed by Messrs. Binney and Hull to be Permian marl and Lower Permian sandstone, were found in a quarry and a well. The Bold Hall Colliery shaft, at about one mile from the outcrop of supposed Permian rocks, proved the shale to maintain its thickness, but the sandstone to be 57 feet 9 inches only. The Coal-Measures were entered at 186 feet, and penetrated to a depth of 1800 feet from the surface, when the Florida Mine was met with. The red staining due to the Trias extended to a depth of 365 feet in the Coal-Measures. The Collins Green Colliery shafts, at the same distance from the boundary of the Trias, but three-quarters of a mile north-east of Bold Hall Colliery, proved the shale to be 22 feet, and the sandstone 44 feet in thickness. The latter contained spherical concretions of iron pyrites, binding the grains of sand in their original position in plains of bedding. The Coal Measures were entered at 310 feet 10 inches, and penetrated to the Florida Mine at 1667 feet 7 inches from surface. They were red for 152 feet. The dip of the so-called Permian was to the south-east at 6°, that of the Coal-Measures at 10°. The Haydock Colliery shafts (Lyme Pits), at the same distance from the boundary of the Trias, are one mile north-east of Collins Green. The shale and sandstone had diminished here to 9 feet and 7½ feet respectively. The Coal-Measures were penetrated to a depth of 97 feet 2 inches, or 413 feet 3 inches from surface. In the shafts of this and the Collins Green Colliery, the unconformity of the red sandstone and the Coal-Measures was clearly visible. The above sections show that the so-called Permian marl and sandstone thin out gradually from west to east, the lower thinning out first, and not the upper, as would have been the case if they had been unconformably overlapped by the overlying beds. They also thin out to the south, as proved by a borehole near Farnworth, three miles south of St. Helen's Junction, which, after penetrating 124 feet of yellow and white sandstone, passed through 3 feet of red and white clay, 3 feet of red sandstone, and entered purple marls with bands of limestone, belonging to the Coal-Measures. The so called Permian beds, though unconformable to the Coal-Measures, are quite conformable to the Trias, and are overlapped in consequence of an attenuation in themselves, and not through having suffered denudation before the Trias was deposited upon them. Considering also their lithological similarity to the Trias, it seems that they should be classed with this formation rather than with the Permian. The Permian rocks are probably ab ent west of Warrington, for two boreholes at Parkside and Winwick, commencing in the Pebble beds, entered the Coal-Measures at 291 and 341 feet respectively without encountering them. The Trias contained a bed of shale about 30 feet thick, and was based by soft sandstone with twig-shaped concretions of iron pyrites. Like the spherical nodules of Collins Green, these probably owed their origin to the action of Coal-Measure water, with sulphides in solution, acting on the colouring matter (peroxide of iron) of the Trias. The Coal-Measures consisted of purple and green marls, and at Winwick were associated with limestone. They, and the same beds found in the Farnworth boring, are precisely similar to the well-known Whiston limestone, and like it contain the *Microconchus carbonarius*. These limestones are probably the equivalents of the Ardwick limestone series in the Upper Coal-Measures of Manchester,[1] and may be found to be underlain by representatives of the coal-seams which are found in connection with it. Without doubt they must be everywhere underlain by the whole of the productive Middle Coal-Measures, but at a great and unknown depth, though there is reason to believe that the thickness of barren measures would be less in West Lancashire.

Remarks upon the Structure and Classification of the Blastoidea, by P. Herbert Carpenter, M.A.—The author and Mr. R. Etheridge, jun., who are preparing a joint memoir upon the Blastoidea, have arrived at the following conclusions respecting the group:—It is very doubtful whether the genus *Pentremites* occurs at all in Britain. Some badly-preserved fragments from the Devonian and the Scotch Carboniferous are possibly referable to it; but most of the Blastoids (besides *Codaster*) which occur in the Carboniferous Limestone belong to the genus *Granatocrinus*, Troost., which is represented by some seven or eight species. Cumberland's *Mitra elliptica* is the representative of a new genus, distinguished by the eccentric position of the spiracles. *Codaster* is a true Blastoid, and not a Cystid, as supposed by Billings. The slit-like openings of its hydrospires are nearly on the same level as the ambulacra, which do not conceal them at all. In the ordinary Blastoids, however, they are below and concealed by the ambulacra, opening externally by pores at the sides of the latter. There are various intermediate forms between these two extremes, in which the hydrospiral slits are more or less concealed by the ambulacra, but are partially visible at their sides. It is proposed to group the species thus distinguished into a genus *Pentremitidea*, which is represented in Britain by the little *Pentremites acutus*, Sowerby, in Belgium by *P. caryophyllatus*, and in Spain by *P. Paulleti*, De Verneuil, for which last the name *Pentremitidea* had been already proposed by D'Orbigny. An arrangement of this kind has been already suggested by Billings. The discoveries of Rofe, Wachsmuth, and Hambach, respecting the perforation of the lancet-piece by a longitudinal canal, are confirmed. This canal probably lodged the water-vessel, which must have been devoid of any tentacular extensions, as in some Holothurians, and in the arms of certain *Comatulæ*. Respiration was effected, however, by means of the hydrospires. The pores usually found at the sides of the ambulacra were not the sockets for the attachment of the appendages, but led downwards into the hydrospires, serving to introduce water, which made its way out through the spiracles. The genital ducts probably opened into some portion of the hydrospires, as they do into the closely similar structures of the *Ophiuroidea*, and the ova were discharged through the spiracles. Billings' statements are confirmed respecting the existence in many species of a single or possibly double row of jointed appendages along each side of the ambulacra; but these appendages are not homologous with the pinnules of the *Crinoidea*. In perfect specimens the peristome is covered in by a vault of small polygonal plates, any definite arrangement of which is rarely traceable. Extensions of this vault were continued down the sides of the ambulacral grooves, which could thus be closed in completely and converted into tunnels, as in recent Crinoids. The classification of the Blastoidea must depend entirely upon morphological principles. Mere differences in the relative sizes of the calyx plates are of very little systematic value; and differences in the numbers of side plates on given lengths of the ambulacra are absolutely worthless. On the other hand, the structure and relative positions of the hydrospires and spiracles are morphological characters of much systematic value.

On the Extension into Essex, Middlesex, and other Inland Counties, of the Mundesley and Westleton Beds, in Relation to the Age of certain Hill-gravels, and of some of the Valleys of the South of England, by J. Prestwich, M.A., F.R.S., Professor of Geology in the University of Oxford.—The author gives in this paper the result of observations commenced more than thirty years since, but delayed publication in consequence of doubts caused by the complexity of the phenomena. As mentioned in the preceding paper, a peculiar group of land, freshwater, and marine beds occupy, on the Norfolk coast, a zone between the Chillesford Clay and the Lower Boulder Clay. As we proceed southward, the land and freshwater conditions are gradually eliminated, and marine conditions then alone prevail. Poorly

[1] This identification was pointed out by Mr. De Rance in the *Trans.* Manchester Geol. Soc. for 1880. ("Further Notes of Triassic Borings near Warrington.")

marked as the marine evidence is in Suffolk, this evidence is entirely wanting further inland, and we have only levels, superposition, and structure to rely on in correlating the fragmentary outliers into which these beds finally resolve themselves. Again on the coast of the Eastern Counties, this group forms a nearly level plain but little above the sea-level, resting everywhere on an undisturbed or very slightly eroded bed of Chillesford Clay, and being succeeded, with but slight evidence of denudation, by the Lower Boulder Clay, or by the Glacial sands and gravel; whereas, as it trends inland, it attains a considerable elevation above the sea-level, passes unconformably over the older Tertiary strata, and has been subjected to a great amount of denudation. On the other hand, the old land, which seems to have extended from the eastward as far as the Norfolk coast, is now in great part below the level of the German Ocean. Further, whereas the succeeding Glacial beds all show a drift from northward to southward, this is the only case that has come under the author's notice of a marine drift from southward to the northward. The Westleton Beds, in their more typical aspect, consist of quartzose sands full of flint pebbles, almost as much worn and as numerous as in the Lower Tertiary sands of Addington. The author then proceeds to trace the beds through Essex, and gives a series of railway sections showing these beds, exhibiting usually the appearance of a white gravel, with intercalated ochreous beds, and reposing on a very eroded surface of the London Clay. In traversing the beds farther westward they undergo further modification. Certain characters remain, however, persistent, and on these we have to rely: (1) The shingle is composed essentially of chalk flint pebbles, becoming less worn as we approach the southern limits of the deposit; (2) it often becomes much mixed with flint pebbles and sub-angular fragments of compact sandstone derived from the underlying Tertiary strata; (3) the chert and ragstone fragments often so increase in numbers as to constitute a large portion of the gravel. They are worn and sub-angular, and the chert is identical with the chert of the Lower Greensand of Kent and Surrey; (4) the pebbles of white and rose-coloured quartz, of Lydian stone, and of white quartzite become rarer, and in places are wanting. The Lydian stone and some of the small quartz pebbles may be derived, with the chert, from the Lower Greensand, but this will not account for the great number of quartz pebbles found in the Eastern Counties. The quartzite pebbles are equally large, but lighter coloured and more ovoid than those of the New Red. They probably have drifted from a continental area on the east, the author having found similar beds in parts of Belgium; (5) the absence of northern drift. The author reserves for another occasion the description of the beds next in order; but he would mention here that the Boulder Clay and some Glacial gravels occupy in Herts and Berks a lower horizon than the Westleton Beds. It would therefore appear that, while the eastern area was submerged, and the strata followed in regular succession upon a surface which did not undergo denudation, the southern and western area was slowly elevated, and underwent partial denudation before the Upper Boulder Clay was deposited. Previous to the period of the Westleton and Mundesley beds, it is probable that the denudation of the Weald had hardly commenced. The area was spread over by Cretaceous strata under water at the beginning of the Crag period (the Lenham beds), and judging from the character of the beds which fringe the North Wealden area at Chelsfield, Cherry Down, &c., the author concludes that there was land south of this fringing shingle, whence the great mass of Chalk-flints and of Lower-Greensand cherts and ragstone must have been derived. This mass of *débris* serves to attest to the great extent of these strata that have been removed from the Wealden area while yet it was an elevated and not a depressed area. After the rise of the area over which the Westleton Beds extended, it underwent extensive denudation, and it was at this period that the great plain of the Thames Valley received its first outlines, although it was not until much later that the river valley received its last impress.

A Contribution to Seismology, by Prof. J. Milne and T. Gray, B.Sc.—It was pointed out that earthquake motion is generally of a very irregular character, that it usually begins gradually, reaches a maximum somewhat suddenly, and afterwards passes through several minima and maxima. The period of vibration of a great number of earthquakes observed by the authors varied between half and one-fifth of a second, while the total time of disturbance varied from one to three minutes. Reasons were given for believing that earthquakes which last for a long time are propagated further than those which last for a short time, even when the intensity of the latter is the greater. As to the determination of the origin of shock, the great value of accurate time observations was pointed out, and a sketch of different modes of making such observations was given. Explanations were entered into with regard to the rotation of bodies during earthquake shocks.

The Glacial Geology of Central Wales, by Walter Keeping, M.A.—The author adduces evidences to show that Central Wales was covered with snow and ice during the glacial period, but all the glaciers of which we have any traces were of strictly local character, each confined to its own drainage area in the present valley system. There is no evidence of any great *mer de glace*, nor of any marine submergence in recent geological times.

On the Lower Keuper Sandstone of Cheshire, by A. Strahan, M.A., F.G.S., Geological Survey of England and Wales.—This paper deals with some of the results of the re-survey of parts of Cheshire, which have been already described in detail in the Geological Survey Memoirs "On the Neighbourhood of Prescot" (third edition), and "On the Neighbourhood of Chester." Several sections, of which the best are at Runcorn and Frodsham, show that there is a strong and constant division between the waterstones and the Keuper Basement Beds. These were formerly classed together under the name of Lower Keuper Sandstone, but, so far as the re-survey has been carried, are now distinguished on the maps. The old and new classifications may be compared as follows:—

Old Classification.	New Classification.
Keuper Marl	Keuper Marl.
Lower Keuper Sandstone ...	Waterstones.
	Lower Keuper Sandstone or Basement Beds.

SECTION D—BIOLOGY

Department of Anatomy and Physiology

On the Conario-hypophysial Tract, or the Pineal and Pituitary Glands, by Prof. Owen, C.B., F.R.S.—The author, referring to the latest contributions to the subject of his paper, remarked that they bore upon the functions of the so-termed "glands." Prof. Sapolini, in his work "L'Aire de la Selle Turcique" (8vo, 1880), concludes that "the pituitary gland secretes the fluid of the ventricles of the brain." Prof. Ed. Van Beneden, in reference to the supposed pituitary gland in Ascidians, regards it as their renal secretory organ (*Archives de Biologie*, 8vo, 1881). In pursuance of his aim, which was homological, Prof. Owen traced the modifications of the pineal and pituitary bodies and connecting parts from man down to the lowest fishes possessing a brain; and noted the progressively increased relative size and retention of tubular structure of the tract, including the so-called "pituitary gland," "infundibulum," "third ventricle," and "pineal gland," as the vertebrate series descended; also the further extension of the pineal part of the tract, beyond the brain, to its perforation of the cranium, leaving the so-called "foramen parietale" in some existing and in many extinct Reptilia. These phenomena were then tested and compared with concomitant phases in the development of the vertebrate, especially the mammalian, embryo. It was shown, as had been noted by previous embryologists, that prior to the permanent anterior outlet of the digestive sac, a production from such sac extended to the large cerebral vesicle, subsequently reduced to a "third ventricle"; whence the hollow tract was continued onward to the epithelial covering of the head, by which it was closed. The lower pharyngeal beginning of this trans-cerebral tract also became closed and modified as the "pituitary body." The upper continuation became modified, and in higher vertebrates closed as the "pineal body"; but the intermediate portion of the tract retained its primitive hollow condition as the "third ventricle" and "infundibulum." The "sella turcica" in mammals, like the "foramen parietale" in cold-blooded vertebrates, were modifications in the skeleton of parts of the "conario-hypophysial tract." This tract, under all its modifications, marked vertically the division between the "cerebrum" and the "optic lobes," or divided the "fore-brain" from the "hind-brain."

The author next proceeded to point out the homologies of the parts of the neural axis in invertebrates with those of vertebrates.

The so-called "supra-œsophageal ganglion or ganglions" in the former were homologous with the "cerebrum, or cerebral hemispheres" in the latter. The so-called "sub-œsophageal masses" in invertebrates answered to the mes-and ep-encephalic

masses in vertebrates. The neural chords and ganglions continued therefrom backwards in invertebrates, answered to, or were homologous with, the myelon or spinal chord of vertebrates, in which the ganglionic structure was more or less concealed, save in some fishes, by superadded neural substances.

Now the supra-œsophageal mass, or "fore-brain," in invertebrates is divided from the subœsophageal masses, or "hind-brain," by the production of a tubular portion of the fore part of the primarily closed alimentary cavity, which, extending between those parts of the neural axis, opens upon the surface of the head so attained, and there establishes the permanent mouth; the tubular extension therefrom similarly retains its functional or œsophageal relations with the alimentary cavity. The neural chords, connecting the so-separated "fore-brain" with the "hind-brain," traversed the sides of this gullet; as the chords or "crura," proceeding to expand into the "fore-brain" of vertebrates, traverse the sides or walls of that persistent part of the conario-hypophyseal tract known in anthropotomy as the third ventricle. The large relative size of the embryonal brain-vesicle in this connection is significative of the homology of the parts extending therefrom.

Passing next to the consideration of the characters which had been held to determine the "back" and "belly" of the animal, the author cited:—"Colour," the "relative position of the body of air-breathers to the ground they stood or moved upon,"[1] and the criterion, which Cuvier adopted to determine these aspects in the notable controversy with Geoffroy St. Hilaire in 1830.[2] That criterion was the cerebrum in vertebrates, and its homologue, the super-œsophageal ganglion, in invertebrates. In an enlarged copy of the diagram by which Cuvier illustrated his position, the author pointed out the grounds on which the great French comparative anatomist exclusively applied the term brain (*cerveau*) to this part of the cerebral centres; moreover, Cuvier expressly rejects the homology of the spinal cord of vertebrates with the ganglionic chord of the body in invertebrates; and he concluded that, however his opponent might turn about his articulate or molluscous subject, the so-called brain would be on opposite sides of the alimentary canal in the two groups compared.

Now, to reconcile this difference, the author pointed out that it only needs to add to Cuvier's diagram of the brain of the mammal the conario-hypophysial tract omitted in that diagram; and, if the facts and deductions in his paper were allowed to be valid, the actual difference would lie in the atrophy of the embryonal homologue of the invertebrate gullet and mouth in vertebrates, and the establishment in them of a new entry into the alimentary cavity.

In the vertebrate embryo this anterior entry makes its first appearance as a capacious branchial or water-breathing organ, and traces of this destination are determinable in the higher vertebrates, in which the respiratory function is ultimately otherwise located and performed in relation to an aërial medium.

The entry to the alimentary cavity in Amphioxus is both a breathing and a feeding mouth: it is a vertical or longitudinal slit bounded by a pair of styles, in which is made the nearest approach to gristle of any part of the sclerous system in that primitive vertebrate. This "mouth" seems to be, or to be formed by, a confluent pair of the branchial openings, such as those which follow after it. To what pair of the costal, hæmal, or vertical side-walls or supports of the higher piscine vertebrate oral cavity, scapular, hyoid, tympano-mandibular, or palato-maxillary ribs, the parial styles of Amphioxus may be homologous, it is hard to say in the absence of skull or brain in that animal. In fishes the double function of the mouth is retained—all are "branchiostomous." In air-breathers the vertical entry becomes exclusively respiratory, and is more or less divided from the alimentary mouth beneath, and the opening or inlet to this becomes transverse by the production of the tympano-mandibular arch and its apposition to the palato-maxillary one above. In ancient forms of vertebrate air-breathers the entry to the narial passage, or respiratory mouth, as it may be termed, is by a pair of openings homologous with a piscine pair of branchial ones, but admitting air instead of water. To these "antorbital nostrils," as they are termed, in Plesio- and Ichthyosaurs, a more anterior single or confluent pair of inlets is added in Teleosaurs. In recent crocodiles the latter becomes exclusively the single, undivided, or partially divided breathing-mouth. In lizards and birds it is commonly divided, or there is a pair of "nostrils." In mammals the nostrils are commonly approximate. But the "feeding-mouth" remains below them as a distinct transverse cleft. In all these modifications the aperture, whether for breathing or feeding, or for both, is on the hæmal aspect of the brain; the vertebrates are hæmastomes; the invertebrates are neurostomes, and the chief part of their brain is "hæmad" of their mouth.

Returning to the criterion of the dorsal and ventral aspects of the animal body, the author maintained that the ganglionic body-chord in invertebrates did answer to the myelon of vertebrates; and adding this to the totality of the brain, the so-called "neural axis" was determined. So determined, he held that its position was the true criterion of the dorsal or neural aspect of the body, whether the animal moved with it next to, or farthest from, the ground, or neither the one nor the other, as in the human pedestrian.

The part or aspect of the body opposite the neural one was characterised by the location of the centre, or chief centres, of the vascular system, and this had led Prof. Owen, at the commencement of his anatomical teaching, to term it the "hæmal aspect."

Referring, finally, to the diagram of the invertebrate and vertebrate animals in corresponding positions, agreeably with the above criterion, the author showed that the so-called "brain" (Cuvier), or the supra-œsophageal brain-mass of comparative anatomy, was not above, but below, the mouth or gullet in invertebrates, and that the sub-œsophageal mass was above the mouth or gullet; also that the reverse relative positions were due to the atrophy of the primitive homologues of such entry in vertebrates, and the substitution of another opening or conduit to the stomach, whereby these anterior openings and conduits are on the lower or hæmal side of the cerebrum in vertebrates, on the upper or neural side of the cerebrum or fore-brain in invertebrates. In briefer terms, the one division was "hæmastomous"; the other division was "neurostomous." The paper was illustrated by drawings, of which enlarged diagrams were exhibited to the Section.

Dr. Montagu Lubbock's paper *On the Development of the Colour Sense* discussed the question of the evidence as to the acquirement of the power of perceiving colour by man within historical times, and also the question whether this perception had been gradually acquired by man or any animal at any time. He concluded that there were good grounds against believing that any such gradual development in the case of man could be proved; and while it was probable that in those animals which lived upon coloured food the power of appreciating colour would gradually arise, yet there was no proof of this yet available, and no idea could be given of the stages by which this had been brought about.

Prof. S. P. Thompson read a paper upon the *Function of the two Ears in the Perception of Space*, in which he stated his view as follows:—Judgments as to the direction of sounds are based in general upon the sensations of different intensity in the two ears; but the perceived difference of intensity upon which a judgment is based is not usually the difference in intensity of the lowest or fundamental tone of the compound sound, or "clang," but the difference in intensity of the individual tone or tones of the clang for which the intensity-difference has the greatest effective result on the quality of the sound. Prof. Thompson further remarked that now that the physical bases of the problem were laid down, the acoustic perception of space might be greatly elucidated by experiments upon persons possessed of abnormal hearing, and upon the blind, in whom this perception is abnormally developed.

Prof. J. C. Ewart of Aberdeen gave an account of the researches *On the Influence of Bacilli on the Production of Disease*, which he has communicated to the Royal Society.

Mr. W. A. Forbes read a paper *On the Incubation of the Indian Python* (*Python molurus*), *with special regard to the alleged Increase of Temperature during that Period*. This paper gave an account of a large series of observations made during the last season in the gardens of the Zoological Society. The python laid about twenty eggs, and incubated for about six weeks. Observations were made upon both male and female, kept in adjoining cages under conditions approximately identical, and it was found that there is an increase of temperature in the incubating female analogous to that which occurs in birds; the amount of increase observed was not so great as others had

[1] The anatomists who adopt this criterion call the hæmal aspect of the lobster its "back," the neural one its "belly"; the right side of the animal is its left side, and *vice versâ*.

[2] Reference was here made to the nineteenth vol. of the *Annales des Sciences Naturelles* for 1830 (March), p. 241, Pl. XII.

tated, being about 1·9° and 3° Fahrenheit, according as the temperature was taken on the surface of the body or between its folds.

Dr. D. J. Cunningham's paper *On the Structure and Homologies of the Suspensory Ligament of the Fetlock in the Horse, Ass, Ox, Sheep, and Camel*, described the particular members of the intrinsic group of muscles which enter into the formation of this ligament. He showed further that the process of transformation of muscle to ligament seemed to be effected by a fatty degeneration of the muscle-fibres with a coincident multiplication of the connective-tissue elements of the muscle; that muscular tissue may exist in the body and have no apparent function, unless it were a purposeless contraction, stimulated by the nerve-supply it received from nerves contained within the ligament. In the transformation the nerves remained unchanged; in the sheep, in which there is not a trace of muscular tissue left, the nerves were relatively as large as in the ox or horse.

Other papers were read, by Prof. Struthers, *On the Acetabulum of Animals in which the Ligamentum teres is described as wanting*, and *On the Correspondence between the Articulations of the Metacarpal and Metatarsal Bones in Man;* by Mr. F. M. Balfour, *On the Nature of the Pronephros, or so-called Head-Kidney of Adult Teleosteans and Ganoids;* by Mr. G. E. Dobson, *On the Digastric Muscle, its Modifications and Function;* and Dr. W. H. Stone, *On the Effect of the Voltaic Current on the Elimination of Sugar*. Altogether fourteen papers were read before this department, which only sat on two days. Half the papers were anatomical, and half physiological. It is to be assumed that the energies of anatomists and physiologists had been so largely occupied with the International Medical Congress that no novelties could be produced on this occasion.

Department of Anthropology

Miss A. W. Buckland, in a paper *On the Geographical Distribution of Mankind*, discussed the problems awaiting solution in anthropology, especially the relations of brachycephalic and dolichocephalic peoples, and the questions of the unity of the race, and of the peopling of oceanic islands and of Australia. She considered that nothing definite could as yet be determined regarding any of these matters.

Mr. Staniland Wake read a paper *On the Papuans and the Polynesians*, in which he came to the conclusion that the primitive stock from which both had sprung was now represented by the Australian race, which had formerly a much wider extension than at present. The existence of two types among the Australians showed they were not a pure race, being probably intermixed with the Negrito. The Polynesians showed considerable traces of this intermixture, while the Papuans had been largely affected by contact with a more modern Asiatic people now represented by the Malays, having been further specially influenced by the intermixture of Arab and Indian blood.

General Pitt-Rivers gave an account of *Excavations in the Earthwork called Ambresbury Bank in Epping Forest*, which showed that it was a camp of British erection, but it was not possible from the excavations made to determine whether it was made before or after the Roman conquest. General Pitt-Rivers read another paper *On the Entrenchments of the Yorkshire Wolds and the Excavations in the Earthwork called Danes' Dyke at Flamborough*, in which he showed that the term Danes' Dyke was undoubtedly a misnomer, for the whole district was the scene of the operations of a much earlier people, who were formidable in their means of offence and defence, and in the discipline necessary to construct the entrenchments, which extended for great distances. At Danes' Dyke he found both flints and flint flakes, showing that the defenders of the earthwork used flint, and lived not later than the bronze period, at the period of the tumuli of the Yorkshire wolds. In a further communication General Pitt-Rivers described his discovery of flint implements in stratified gravel in the Nile Valley, near Thebes.

Dr. Beddoe gave an interesting abstract of results *On the Stature of the Inhabitants of Hungary*, based on recruiting statistics. The average Hungarian soldier was about 5 feet 5⅜ inches high. The Germans and Croats gave taller men than the Magyars. The citizens of Budapesth were taller than countrymen at the age of twenty. In five western counties (including Pesth), where the population was mainly Magyar, the mean stature at twenty-five years might be taken as 5 feet 5·2 inches.

A paper *On the Physical Characters and Proportions of the Zulus*, read by Mr. Bloxam, gave the details of an examination of sixteen male and three female Zulus brought to this country, and measured in the presence of Prof. Flower, General Pitt-Rivers, Mr. Roberts, and Mr. F. Galton. It appeared that the average stature of the males was 67·3 inches, one-third of an inch less than the average Englishman of the same age. The average chest girth was 36·5 inches; Englishman's, 35·25 inches; average weight: Zulu, 151 lbs.; Englishman, 141 lbs. Of course the Zulus, being exhibited for their dancing and spear-throwing accomplishments, were in high training, and very well developed in muscle.

Mr. E. F. im Thurn, in a paper *On the Animism of the Indians of British Guiana*, dwelt at some length on the confusion introduced by the application to animism of the terminology and conceptions of higher religious systems. The Indians of Guiana had an animism of a very pure and primitive kind, very little affected by the modifications which change animism into higher religion. They had no belief in the everlasting duration of the spirit, no ideas corresponding to heaven, hell, and retribution, no knowledge of purely spiritual beings, *i.e.* gods, and no worship, though certain arts were practised to avoid attracting the attention of malignant beings.

Mr. Park Harrison, in exhibiting a collection of photographs of types of different races in the British Islands and in France, urged the necessity, for the purposes of scientific comparison, of having photographs taken of uniform size, both in full face, and sufficiently in profile to show the brow, the projection of the nasal bone, and also the form of the ear, which appears to be a racial characteristic, though much disguised by mixture of blood. This, however, would be attended with expense greater than the Anthropometric Committee could afford. Prof. Flower, in commenting on this communication, said the subject had scarcely yet been fairly attacked in this country; it was only by the photographing of numbers in each part of England that they might ultimately have a chance of arriving at the types of the principal races that had contributed to the mixtures now prevailing. There was great difficulty in forming an opinion as to what types people really represented; no doubt the comparison of photographs, done on a certain scale, would be of much value in this matter.

The Anthropological Department sat on five days, and thirty-seven papers or reports were presented to it. Among others that we may particularise as of interest were those by Mr. J. R. Mortimer, *On Six Ancient Dwellings found near to British Barrows on the Yorkshire Wolds;* Mr. Francis Galton, *On the Application of Composite Portraiture to Anthropological Purposes;* Mr. J. Harris Stone, *On the Viking Ship discovered at Sandefjord, Norway, in* 1880; Mr. Hyde Clarke, *On the Early Colonisation of Cyprus and Attica, and its Relation to Babylonia;* Mr. H. Stopes, *On Traces of Man in the Crag;* Prof. T. McK. Hughes and Mr. A. W. Wynn, *On the Age of the Deposits in the Caves of Cefn, near St. Asaph, with special reference to the Date of Man's first Appearance in them.*

Department of Zoology and Botany

Sir John Lubbock's paper *On the Sense of Colour in Animals* first dealt with Bonnier's experiments on bees, and showed many fallacies in them, which were avoided in a series of his own observations recently made. He took slips of glass of the size generally used for microscopic work, and pasted on them slips of paper coloured blue, green, orange, red, white and yellow, and induced a bee to visit all in succession when covered by a plain slip on which was a drop of honey. Then the honeyed slips were removed, and the situation of the coloured glasses was changed; when the bee returned from the hive the order of its visits to particular colours was noted, and the result of 100 different experiments was that blue was the bee's favourite colour, then white, yellow, and green. The observations were varied in several different ways, with the same results. The question naturally arose, How then are there so few blue flowers? Sir John believed that all flowers were originally green, and that they have passed through stages in which they were white or yellow, while many have become red, and finally blue. This was supported by facts such as the following:—In Ranunculaceæ many simple open flowers, as buttercups, were yellow or white; while the blue delphiniums and aconites were of highly specialised form, and therefore probably of more recent origin. Among the Caryophyllaceæ the red and purplish species were among those with highly specialised flowers, while the simple flowers, as stellaria and cerastium, were mostly white. Among violets many of the most highly specialised forms were blue; the simpler ones yellow. In gentians, again, the deep-blue

species have long tubular flowers specially adapted to bees and butterflies, while the yellow gentian has a simple open flower with exposed honey. Sir John also described his experiments made on daphnias by illuminating a trough with an extended solar spectrum in such a way that after a given lapse of time he could isolate the portion of the trough illuminated by each principal colour, and count the number of daphnias in it. They appeared to have a very predominant preference for the red and yellow and greenish yellow and green. He also found, contrary to the conclusion of M. Paul Bert, that they clearly perceive the ultra violet rays.

Sir John Lubbock read a paper *On the Mode in which the Seed of Stipa buries itself in the Ground*.—One of the most interesting parts in botany, he said, was the consideration of the reasons which led to the different forms, colours, and structures of seeds; and it was, he thought, pretty well made out that a large proportion of those might be accounted for either as serving to protect the seed or to assist in its conveyance to a place suitable for its growth. If the seeds of trees fell directly to the ground it was obvious that very few of them would have a chance of growing. It was an advantage to them, therefore, of which many availed themselves, to throw out wings, in consequence of which the wind wafted them to a greater or less distance. Others, such as the whole tribe of nuts, being edible, were carried about by beasts and birds, and though some were sacrificed, others survived. Fruits, again, in consequence of their sweetness, were carried about by animals, which, after partaking of the fleshy portion, dropped the seeds themselves. Many seeds were covered with hooks, and thus, adhering to the wool of sheep and other animals, were carried to greater or less distances. Others, like those of our common dandelion, were provided with fairy parachutes, and were thus borne away by the wind. Others again, like some of the violets, geraniums, vetches, brooms, cucumbers, cardamine, oxalis, and others, had beautiful and varied contrivances, by which they actually threw the seeds to a distance, in some cases of more than 20 feet. Others, again, were enabled to penetrate the earth, and thus sow themselves in the ground. In one of our English clovers, *Trifolium subterraneum*, after the flower had faded, it turned downwards, and buried itself in the ground. The ground nut of the West Indies, and more than one species of vetch, had a similar habit. In the *Erodiums* or Crane-bills, the fruit is a capsule, which opens elastically, and as in the case of the allied geraniums, sometimes threw seeds to some little distance. The seeds themselves were spindle-shaped, hairy, and produced into a twisted awn. The number of turns on the awn depended upon the amount of moisture. Mr. Rowe, to whom they were indebted for an account of their mechanism and mode of action, said if a seed be laid upon the ground, it remained quiet as long as it was dry, but so soon as it was moistened the outer side of the awn contracted, and the hairs surrounding the seed moved outwards, the result of which was to raise the seed into an upright position. The awn then gradually unrolled, consequently elongating itself upwards, with the result that if it was entangled amongst any of the surrounding herbage, the seed was forced into the ground. A still more remarkable case was that of the *Stipa pennata*. The actual seed was small, with a sharp point, and with stiff short hairs pointing backwards. The upper end of the seed was continued into a fine twisted rod; then came a plain cylindrical portion attached at an angle to the corkscrew, and ending in a long and beautiful feather—the whole being about a foot in length. That end was supposed by Mr. Francis Darwin, to whom they were indebted for a very interesting memoir on the subject, to act very much in the same manner as that of *Erodium*, already mentioned. He did not doubt that the end would bury itself in the manner described by Mr. Darwin, but he doubted whether it always did so. One fine day, not long ago, he chanced to be looking at a plant of that species, and around it were several seeds more or less firmly buried in the ground. There was a little wind blowing at the time, and it struck him that the long feather awn was admirably adapted to catch the wind, while on the other hand it seemed almost too delicate to drive the seed into the ground in the manner described by Darwin. He therefore took a seed and placed it upright on the turf. The day was perfectly fine, and there could therefore be no question of hydroscopic action. Nevertheless, when he returned after a few hours, he found that the seed had buried itself some little distance in the ground. He repeated the observation several times, always with the same result; thus convincing himself that one method, at any rate, by which seeds bury themselves is by taking advantage of the action of the wind, and that the twisted position of the awn, by its corkscrew-like movement, facilitates the entry of the seed into the ground.

Mr. A. W. Bennett read a paper *On the Constancy of Insects in Visiting Flowers*. He said he was not aware that attempts had yet been made to determine the question whether insects were altogether discriminating in their visits to flowers, or whether on the same journey they confined themselves exclusively or chiefly to one species. That paper, which was the result of observations during the fine weather of the last two years, was intended as a contribution towards the settlement of that question, obviously one of some importance in relation to the cross fertilisation of flowers by insects. Those who had not made the experiment would hardly appreciate how difficult it was to watch continuously for any considerable period the flight of any insect. He had chosen in all cases as points of observation spots where a considerable number of different flowers grew in profusion, and were intermixed, so that the insect would have abundant opportunity of changing its diet if so disposed. In recording the number of flowers of the same kind visited by an insect in the same flight, he always meant flowers at such a distance from one another that the insect had to use its wings in getting from one to another. In August of last year he observed three different flights of the "painted lady" butterfly, and it settled six, three, and ten times respectively, always confining itself to the same species of flower. On the same plot a hive-bee paid nine successive visits to the same species of flower. On another plot a bumble-bee visited the same species of flower fifteen times, and another of the same species eleven times in succession, not touching any other flower, but passing over many. Mr. Bennett gave further results of his observations on different occasions and in different parts of the country. In order to test whether insects were guided by colour only when visiting flowers, he watched one spot where there were white and purple foxgloves, but a large bumble-bee was seen to enter sixteen of the flowers regardless of colour, although to find the succession of foxgloves it had to fly considerable distances over other flowers. No general statement could be made as to the consistency of insects in visiting the same species of flower during the same flight. A decided preference for successive visits to the same flower was unquestionably shown in many instances, but those visits did not depend on the colour of the flower only. The hive-bee appeared to be by far the most constant in that respect, often absolutely so. From their strong and rapid flight and extremely hairy covering of their abdomen, that class of insects was probably the most efficient agent in the dissemination of pollen. So far as could be gathered from observation, the "painted lady" and the small tortoise-shell butterflies were very consistent, while the whites, the blues, and the browns were far from catholic, or less discriminative in their tastes. It was open to question, however, whether more than a very few flowers were dependent upon butterflies for their fertilisation. At all events their visits to flowers were often only interludes in their settlements on grass, leaves, the stems of trees, or the bare ground.

Prof. O. C. Marsh of Harvard, U.S., contributed one of the most attractive papers to this department, *On Jurassic Birds and their Allies*. He detailed the results of his examination of the Archæopteryx in the British Museum, the more recently discovered specimen at Berlin, and of Compsognathus in the Munich Museum, as compared with the forms previously made known by himself in America. His impression was that the two specimens of Archæopteryx were specifically identical, although fuller evidence might prove them to be distinct. He still considered that we knew little that could determine how or at what period birds originated. At present the four oldest known birds were as distinct from one another as any birds of the present day. Yet if he were asked to distinguish between the bones of a reptile such as Compsognathus and a bird such as Archæopteryx, if broken up and mixed together, he should be puzzled to do it. Prof. H. G. Seeley, in the subsequent discussion, stated his belief that the British Museum Archæopteryx was not merely specifically, but generically distinct from that at Berlin.

Dr. A. A. W. Hubrecht of Leyden gave an interesting exposition of *The Structure and Affinities of Proneomenia*, one of the valuable finds of the *Challenger* Expedition. Dr. Hubrecht spoke in excellent English, and was listened to with much appreciation.

Mr. Forbes gave an account of his work *On the Anatomy and*

Classification of the Petrels, based upon those collected by the *Challenger* Expedition. He divided them into two main families —the Oceanitidæ or Oceanic Petrels, with four genera and seven species, and the Procellariidæ, divisible into three sub-families of albatrosses, diving petrels, and true petrels. As to descent, he considered the petrels were probably much modified descendants of some ancient form related to the ciconiform birds of Garrod, *i.e.*, the storks, American vultures, and their allies. Mr. P. H. Carpenter, M.A., read papers *On the various Larval Forms of Comatula*, and also *On the Species of British Comatula*. Other zoological papers of interest were by Prof. Busk *On the Use of the Chitinous Appendages of the Skeleton in the Cheilostomatous Polyzoa in the Diagnosis of Species;* Mr. W. T. Blanford, F.R.S., *On our Present Knowledge of the Fauna Inhabiting British India and its Dependencies;* Mr. P. A. Geddes, *Notes on Chlamydomyxa*, and *On a New Sub-Class of Infusorians;* Gen. Sir J. E. Alexander, *On the Improvement of Freshwater Fisheries*, and a further report was made *On the Marine Zoology of South Devon.*

Among other botanical communications we may note those of Mr. J. G. Baker, F.R.S., *On the Botany of Madagascar;* of Mr. A. W. Bennett *On the Colours of Spring Flowers;* of Mr. Joseph Lucas *On some Vestiges of the Ancient Forest of Part of the Penine Chain.* The department sat during five days, and twenty-eight communications were disposed of, including twenty zoological and eight botanical; the latter, however, fully divided the interest with the former, owing mainly to the papers of Sir John Lubbock and Mr. Bennett.

NOTES

Dr. Rudolph König of Paris, whose acoustical fame is world-wide, is about to publish in one volume, in the French language, his remarkable researches in acoustics, which have appeared at intervals in the *Annalen der Physik* and elsewhere, during the past fifteen years. The work will, we understand, be liberally illustrated with drawings of the newer and more important pieces of apparatus which Dr. König has invented.

M. Pasteur, it is stated, has resolved to visit the Bordeaux lazaretto to study yellow fever, and ascertain whether it is due to a parasite, and can be guarded against by inoculation.

The building of the Observatory of the Pic du Midi has been completed on the very top of the mountain, at an altitude of 2600 metres. The old building, which was placed in a valley at a less elevated situation, will be used merely as a station for travellers. General Nansouty is now busy fitting the establishment with apparatus and victuals for next winter, as, according to every probability, it will be blocked by snow during more than six months. The storms are so heavy that not less than six electric light conductors have been established for protection.

The autumn meeting of the Iron and Steel Institute will be held in London this year, on October 11–14, at the Institute of Civil Engineers, under the presidency of Sir Henry Bessemer, F.R.S. Numerous excursions have been arranged for, and the following papers are announced to be read:—On the manufacture of steel and steel rails in the United States (supplementary paper), by Capt. W. R. Jones, Pittsburg, Pa.; on a method of securing homogeneity in the Bessemer process, by Mr. W. D. Allen; on the manufacture of ordnance at Woolwich, by Col. Maitland; on the application of wrought iron and steel to the manufacture of gun carriages, by Mr. H. Butter; on the manufacture of projectiles, by Mr. J. Davidson; on the distribution of elements in steel ingots, by Mr. G. J. Snelus; on the use of brown coal in the blast furnace, by Prof. P. Ritter von Tünner, Leoben, Austria; on certain physical tests and properties of steel, by Mr. Edward Richards; on the tin-plate manufacture, by Mr. Trubshaw; on the use of American anthracite in the blast furnace, by Mr. J. Hartman, Philadelphia; on variation of elements in cast-steel ingots, by Mr. F. Stubbs; and on the recent progress of the basic Bessemer process, by Herr Paul Kupelweiser, director of the Witkowitz Works, Austria.

Great preparations are being made in Dublin for the forthcoming meeting of the Social Science Congress, which begins its sittings there on the evening of Monday, October 3, when Lord O'Hagan, as president, will deliver the inaugural address in the Exhibition Palace. Among the other addresses to be given are the following:—"On Education," by Sir Patrick J. Keenan, K.C.M.G., C.B.; "On Health," by Dr. Cameron, M.P.; "On Economy and Trade," by Mr. Goldwin Smith; and "On Art," by Lord Powerscourt. During the week garden parties and *conversazioni* will be given by some of the leading citizens and learned societies.

Baron Mikluho Maclay, before leaving Sydney, gave to the Linnean Society of New South Wales on July 25 a short account of the progress of the Sydney Biological Station at Watson's Bay, which has been opened through his energies, and of which we recently gave some account. The building was to be ready in a week's time, Dr. Maclay stated. The Royal Society of Victoria have agreed to assist the establishment of the station, not only by personal subscription, but also by an annual grant from the funds of the Society. This last decision is most important, opening the prospect of a permanent, if moderate, subsidy for the support of the institution. The Royal Society of New South Wales will also probably, on the representation of the President at the last annual meeting, follow a similar course. "I entertain the hope," Dr. Maclay said, "that the establishment of the Biological Station of Sydney will very probably induce the other colonies to follow this good example, and will be the means of uniting the scientific societies of different colonies. That the Biological Station of Sydney will not remain long isolated in this part of the world is a fact, as Dr. Hector told me that he intended to establish one in New Zealand. The establishment of an Intercolonial Biological Association, which should have for its object to assist in the formation, maintenance, and regulation of biological stations in Australia, was a plan which, in my opinion, ought not to remain long a *pium desiderium* only. Therefore I called a public meeting, June 15, with the object—1. To obtain a number of yearly contributors, as the subsidy from the Government is in proportion to the public subscription, and the yearly subsidies from the Royal Society of New South Wales and Victoria are very moderate. 2. To frame rules for the station. From the gentlemen present at the meeting a committee was chosen for the discussion of the proposed rules, this committee consisting of six members, of which four are at the same time trustees of the Biological Station; after four meetings, agreed to a code of rules, which will be submitted to the trustees of the Biological Station." Certainly science in Australia is greatly indebted to the intelligent energy of the Russian naturalist, and we trust the work so well begun will be continued without abatement.

The Epping Forest and County of Essex Naturalists' Field Club's annual Cryptogamic meeting is advertised for Saturday, October 1. The Club is to be congratulated for the list of well-known botanists who appear as referees and conductors. Thus for Fungi we see the names of Dr. M. C. Cooke, M.A., F.L.S., Mr. Worthington Smith, F.L.S., Dr. H. T. Wharton, M.A., F.L.S., and Mr. James English; whilst for Mosses and Lichens the names of Dr. Braithwaite, F.L.S., and Mr. E. M. Holmes F.L.S., are announced.

The Yorkshire Naturalists' Union will have a Fungus Foray on Friday and Saturday, September 30 and October 1, at which they will gladly welcome any mycologists who may be disposed to assist them. The Friday's programme is to consist of an excursion in the neighbourhood of Harrogate. On the Saturday is to be a "show," at which will be exhibited fungi, and any objects illustrative of the subject which may be sent. The dinner is to be on the evening of Saturday. Arrangements are being made to search localities in all parts of Yorkshire for specimens to exhibit; and at the meetings the Union will be

honoured by the presence of Messrs. W. Phillips, C. B. Plowright, G. Massee, and Rev. J. E. Vize.

No less than ten observers are now engaged at the Observatory of Paris in the completion of the catalogue of stars which was begun by Leverrier. The work is progressing at an unprecedented rate, not less than 70,000 observations having been tabulated, after having been duly reduced in a single year. Admiral Mouchez has taken possession of the new Observatory grounds, and the earthworks for the foundation of the great refractor building, and the construction of the underground chambers in which the magnetic observations are to be conducted, is being continued.

DURING the York session of the British Association a most successful half-yearly meeting of the members of the Natural History Society of the Friends' School in Bootham was held in the lecture-room of that establishment. Among those present were Prof. S. P. Thompson, F R.A.S., J. G. Baker, F.R.S., A. W. Bennett, F.L.S., J. Edmund Clark, F.G.S., Thomas Gough, M.A. (of Elmfield College), Rev. T. A. Preston, M.A. (Science Master of Marlborough College), Dr. W. W. Newbould, Langley Kitching, Ed. Grubb, M.A., Hugh Richardson, R. M. Christy, A. J. Wigham, with J. F. Fryer, B.A. (the pre ent head master), Fielden Thorp, B.A. (the former superintendent), who presided, and many others. Dr. D. Hack Tuke delivered an interesting address strongly advocating the study of science. Mr. Baker of Kew said that a large measure of his success in life was due to the early scientific training he had received when a member of this society. Many other interesting addresses were given by those present. The Society is only three years younger than the British Association itself, having been formed on August 14, 1834. Since that time many ardent naturalists, now well known to science, had passed through its ranks.

A CORRESPONDENT from Kingussie, in Inverness-shire, writes: "We had just (Sunday, 18th) been reading somewhat sceptically the paragraph about the pink rainbow, when behold, to our astonishment, there appeared just over Glen Feshy the most lovely pink rainbow you can imagine, shaded from crimson to pale pink, but no other colour. It was strange and beautiful, and none of us had ever seen anything like it before."

THE just-issued volume of the *Proceedings* of the Natural History Society at Berne (Nos. 979-1003) contains, besides minutes of proceedings and small notes, several valuable papers: by Prof. Studer, on the segmentation of Madreporaceæ, on the corals of Singapore, and on the statistical researches as to the colour of eyes and hair of children in the canton of Berne; by Dr. Graf, on the specific heat of gases at constant volume; on glacial deposits at Berne, by M. Bachmann; on the intrusion of limestones into the crystalline rocks of the Finsteraarhorn, on the dependence of organisms upon oxygen, and on the influence of poisons on invertebrata, by Dr. Arnold; and several anatomical notes by Prof. Luchsinger.

WE have received the *Proceedings* of the sixty-third annual meeting of the Swiss Society of Naturalists, which was held in September last year at Brieg. They contain the address of the president, M. Wolf, and minutes of proceedings of the sections, among which we notice communications:—by Prof. Rütimeyer, on the metamorphoses of skulls; by Prof. Yung, on his physiological researches on cephalopods at the Naples Zoological Station; by M. Lory, on geological researches on the Finsteraarhorn; and by M. de la Harpe, on the nummulitic formation in Switzerland. In the Reports of Commissions we notice the report, by Prof. Rütimeyer, on the important work, by M. Ph. Gosset, on the glacier of the Rhone, to which the Schläfli Foundation was awarded. This immense work, which is the result of six years' consecutive measurements of the positions of no less than 156 numbered and painted blocks, carefully chosen on the surface of the glacier, as well as of surveys on the scale of 1 : 5000, contains a thorough description of the glacier of the Rhone, and is accompanied by a most elaborate map of the glacier, numerous transverse and longitudinal sections, and several sheets of drawings, which show the results of the the measurements as to the motion of the glacier.

STATISTICAL researches as to the colour of the hair and eyes of children had been made in all the cantons of Switzerland, with the exception of Berne, Geneva, and Tessino. The investigation as to the first of these cantons is now terminated, and the results of the examination of 94,221 children are published by Prof. Studer in the *Proceedings* of the Berne Society of Natural History (No. 986), and are accompanied by four coloured maps, which show graphically the results. It is seen from these researches that in the canton of Berne the dark type prevails over the fair, but that the pure types are not so numerous, especially in the central parts, as the mixed ones. The pure fair type, which makes 9 to 11 per cent. in the north-eastern parts of the canton, increases to the south (11 to 14 per cent. in the middle parts, and 15 to 20 per cent. in the Alps), and reaches its highest percentage in the secluded valley of the Saanen (28 per cent.). The dark type is most numerous in two regions—that of the western lakes and Old Rhætia (21 to 29 per cent.), whilst in the middle parts it reaches only 21 to 25 per cent., and only 16 to 20 per cent. in some secluded valleys. After having shown the distribution of mixed types, Prof. Studer considers these data in connection with history, and comes to several interesting conclusions.

MESSRS. SONNENSCHEIN AND ALLEN have issued a second edition of Prantl's "Elementary Text-book of Botany," revised by Dr. S. H. Vines, who has made considerable alterations in the book, with the view of increasing its usefulness. The most important alteration, it is stated, is the adoption of a Classification of Flowering Plants which will be more familiar to English students than that which was followed in the first edition.

A RECENT speech of the Governor of Hong-kong, Sir John Pope Hennessy, contains an interesting account of the spread of vaccination amongst the Chinese in the Colony and on the neighbouring mainland. No port in the world is more liable to a visitation of small-pox, yet it never spreads there. The health-officer of the Colony also was astonished to find that nearly all the young Chinese emigrants had vaccination or inoculation marks upon their arms. He says he was often puzzled to know how this vaccination came to be apparently so perfect among the Chinese. On inquiry it turned out that the native doctors of the Tung-wa Hospital—a charitable institution supported by the voluntary contributions of Chinese—not only vaccinated their countrymen in the Colony itself, but actually sent travelling vaccinators over the adjoining provinces of China. In this way thousands of people have been vaccinated during the last four years. The lymph is supplied them by the Governor, who gets it every mail in his despatch-bag from Downing-street. Three dentists also appear in the census of the professions of the Colony. "About eighteen months ago," adds his Excellency, "I visited one, not professionally, but for the purpose of seeing the instruments he used, and I then found he had the same apparatus we find in all dentists' establishments. In fact he did work for the first-rate American dentists we have here, being fully capable of making or repairing sets of teeth. He was a gentleman of intelligence, and impressed me, I must say, as favourably as a dentist could."

THE Congress of Orientalists has had a very successful meeting at Berlin. Of the International Geographical Congress and

Exhibition at Venice, we hope to give a detailed report next week. An Archæological Congress was opened at Tiflis on Tuesday; among the delegates is Prof. Virchow. The Caucasus Museum was also opened; the collections were very numerous and varied.

THE ensuing session of the Aristotelian Society for the Systematic Study of Philosophy will open on October 10, at 20, John Street, Adelphi, W.C., with an address by the president, Shadworth H. Hodgson, LL.D., and the Society will thereafter continue its historical studies, alternated with discussions of philosophical questions.

WE gladly welcome the appearance of the "Phænogamous and Vascular Cryptogamous Plants of Michigan," by Charles F. Wheeler and Erwin F. Smith (Lansing, 1881). 1559 species of flowering plants are enumerated, and 75 of horsetails, ferns, and lycopods. The arrangement followed is that of the fifth edition of Gray's Manual, and the authors promise to publish addenda from time to time.

WE have received the first part of Fr. Westhoff's "Käfer Westfalens," forming a supplement to the "Verhandlungen des naturhistorischen Vereins der preussischen Rheinlande und Westfalens," Jahrgang 38 (1881). It is only a List, prefaced by remarks on the district, and with list of authors, &c., but it promises to be of value on account of the thorough manner in which it appears to be worked out, and the beetle-fauna appears to be rich. Adopting the latest European Catalogue as a basis, this first part extends to the *Heteroceridæ*. No new species are described, but several apparently new varieties in the *Carabidæ* and water-beetles receive names.

UNDER the direction of the Council of the Meteorological Society, Mr. W. Marriott has issued "Hints to Meteorological Observers, with Instructions for taking Observations, and Tables for their Reduction" (Stanford). Many of our readers might be able to turn these Hints to good practical account. We have also received the first number of the *Meteorological Record*, containing the monthly results of observations made at the stations of the Meteorological Society, with remarks on the weather for the quarter ending March 31.

THE Report of the Committee of the Queenwood College Mutual Improvement Society for the end of the summer term 1881 is interesting, showing that much useful and varied work is being done by the Society.

THE additions to the Zoological Society's Gardens during the past week include a Malbrouck Monkey (*Cercopithecus cynosurus*) from West Africa, presented by Mrs. Paterson; a Macaque Monkey (*Macacus cynomolgus*) from India, presented by Mr. Harding Cox; a Rubiginous Cat (*Felis rubiginosa*) from Ceylon, presented by Mr. Charles E. Pole Carew; a Brown Bear (*Ursus arctos*) from Russia, presented by Messrs. Morgan, Gellibrand, and Co.; two Chukar Partridges (*Caccabis chukar*) from India, presented by Col. Thos. Pierce, 16th Regt. Bombay N.I.; two Dwarf Chamæleons (*Chamæleo pumilis*) from South Africa, presented by Mr. Duncan W. B. Swaine; two Spanish Terrapins (*Clemmys leprosa*) from Spain, presented by Major Rooke; a Diamond Snake (*Morelia spilotes*) from Australia, presented by Mr. C. C. Sharratt; two Cape Crowned Cranes (*Balearica chrysopelargus*), two Wattled Cranes (*Grus carunculata*) from South Africa, deposited; a Black-faced Spider Monkey (*Ateles ater*) from South America, on approval.

PHYSICAL NOTES

DR. R. KÖNIG has just completed a new instrument—a variety of the wave-siren which we recently described—with which he proves an extremely important fact, which probably is *new* to all acousticians, namely, that the quality of a compound tone is very distinctly affected by differences of *phase* in the components. An account of these last researches will be found in the forthcoming number of *Wiedemann's Annalen*.

DR. KÖNIG describes (*Wied. Ann.*, No. 8) a way of exploring the interior of organ-pipes (especially stopped ones) while in action, without disturbing the vibrations. The pipe, with a central longitudinal slit made in the back, and a plate-glass front, with scale, is supported horizontally in a trough, so that the slit and half the back of the pipe dips in water. A thin brass tube, bent twice at a right angle, is supported on the pipe, so that one end enters the slit to about the middle of the pipe. This tube can be slid along the pipe, and is connected by a caoutchouc tube to the ear, a manometric capsule with flame. Passing through a ventral segment, one notices a quite sudden weakening of the sound, then a sudden strengthening (like the stroke of a bell). By noting such points the position of the segment can be exactly determined. Dr. König gives some results which apparently fail to accord with theory. He also describes a drum-like arrangement for exploring pipes.

AN extremely ingenious piece of electric mechanism is now being shown in the Electrical Exhibition in Paris. It is an apparatus by which any number from 1 to 999 is automatically signalled on one wire by a single movement of the operator, the figures appearing at the distant end at an opening in a box. To describe the details of this apparatus would take too long a space. It is the invention of Mr. J. Mackenzie.

M. CORNU has constructed a polarising prism made of a single film of Iceland-spar fixed with Canada balsam between two flint-glass prisms. The polarisation is far from perfect, however, and the field is very narrow, so that the instrument, though of interest from a theoretical point of view, is of little or no practical value.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—An examination will be held at Exeter College on Thursday, October 13, for the purpose of filling up a Natural Science Scholarship, tenable for four years during residence. The examination will be in biology, chemistry, and physics. Candidates will be expected to show proficiency in at least two of these subjects, and the scholar will be required to read for honours in biology in the Natural Science School. The same papers will be set in chemistry and physics as in the examination for the Natural Science Scholarship at Trinity College. Candidates are desired to call on the Rector between 6 and 7 p.m. on Wednesday, October 12. They may obtain further information by application to the Rector, or to Mr. W. L. Morgan, the Lecturer in Biology at Exeter College.

THE Prospectus of Lectures and Classes for the first Session of University College, Nottingham, promises well. There will be both day and evening lectures and classes in Language and Literature (Prof. Symes), Mathematics, Mechanics, and Physics (Prof. Fleming), Chemistry (Prof. Clowes), Natural Science (Prof. Blake).

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